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THE HIDDEN ROLE OF THE "CO-" PARADIGM IN THE CONCEPTUALIZATION AND APPLICATION OF LIVING LABS

Madelina E. DiLisi
Michigan Technological University, medilisi@mtu.edu

THE HIDDEN ROLE OF THE "CO-" PARADIGM IN THE CONCEPTUALIZATION AND APPLICATION OF LIVING LABS

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Madelina E. DiLisi

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Department of Social Sciences

Thesis Co-Advisor:	*Angie Carter*
Thesis Co-Advisor:	*Adam Wellstead*
Committee Member:	*Kathryn Hannum*
Committee Member:	*Anat Gofen*

Department Chair:	*Don Lafreniere*

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Author Contribution Statement

The research completed in the first two empirical chapters was part of two larger research projects directed by my two co-advisors Dr. Carter and Dr. Wellstead. First, the case study of the Lake Superior Living Labs Network was completed under the supervision of Dr. Carter when I was enrolled in the Undergraduate Program for Exploration and Research in Social Sciences (UPERSS). I continued this work under Dr. Carter's supervision as part of my graduate research. With direction from my advisor Dr. Carter, I designed interview questions for LSLLN members and developed coded categories with consultation.

The second empirical chapter consists of a bibliometric analysis using the software VOSviewer. This work is part of a larger research project with my co-advisor Dr. Wellstead studying policy innovation labs funded by the National Science Foundation and the US-Israel Binational Science Foundation. In my research of Policy Innovation Labs (PILs) and living labs under the supervision of Dr. Wellstead, we recognized a gap in the living lab literature with the absence of the "co-" paradigm. The research conducted for the living labs bibliiometric analysis will be developed further to be submitted for publication in the Public Administration literature.

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Abstract

In the past two decades, the living lab has emerged as an innovative approach for addressing a wide range of issues. Living labs challenge traditional top-down research and development approaches in an array of subjects including climate change and sustainability, healthcare, information communication technology, and urban planning. Despite their growth, the current conceptualization of living labs is incomplete. The conceptual ambiguity surrounding living labs prevents researchers and practitioners from appreciating their true value, limitations, and appropriate applications. My thesis builds on Dekker et al.'s (2020) living lab research by including key concepts from the "co" paradigm literature that includes the role of co-creation, co-design, and co-production in the living lab research approach. In the first empirical chapter, a bibliometric analysis of 551 documents utilizes the mapping software VOSviewer providing an overview of broad trends in the living lab literature. The results confirm Dekker et al.'s (2020) framework as well as the presence of the "Co-" paradigm in the living lab literature. My second empirical chapter is a case study of the Lake Superior Living Lab Network (LSLLN) using grounded theory methods (Charmaz, 1996) in my analysis of interviews with LSLLN members and a content analysis of LSLLN's website.

The Emergence of Living Labs as a Research Methodology: What Do We Know So Far?

Introduction

How can researchers accurately discuss the value and impact of a research methodology that avoids definition? This is the case for the living lab methodology. Over the past two decades, the living lab has emerged as an innovative response to a growing number of complex social, political, economic, and environmental issues. Living labs represent a physical space, collaborative entity and research methodology (Dekker et al., 2020). The living lab methodology has been implemented to address a variety of public policy issues, often leading them to be characterized under the broader umbrella of public section innovation (PSI) and policy innovation labs (PILs). However, there is a growing body of evidence to support that living labs are a distinct research methodology producing unique social innovations rooted in place. Despite growing applications and attention in the literature, the living lab methodology suffers from conceptual ambiguity.

My research contributes to the ongoing discourse on living labs by identifying how this emerging research methodology has been conceptualized thus far in the literature and how this research methodology is being applied by a network of living labs to address various issues in my region. The four core elements of living labs identified Dekker et al. (2020) guide my research as I work to clarify the conceptualization and application of living labs as a research methodology. Furthermore, my research expands upon Dekker et al.'s (2020) findings by addressing the hidden role of the "co-" paradigm

in the living lab methodology by bringing attention to “co-” production and “co-” design in addition to “co-” creation.

My research questions regarding the conceptualization and application of living labs stem from my work as a research assistant on two larger research projects directed by my co-advisors Dr. Wellstead and Dr. Carter. The first research project was directed by Dr. Wellstead studying policy innovation labs and funded by the National Science Foundation and the US-Israel Binational Science Foundation. The second research project was directed by Dr. Carter as part of the Undergraduate Project for Exploration and Research in Social Sciences (UPERSS). Through these two research projects I was able to dive deeper into the living lab methodology with the guidance and support of my co-advisors.

My thesis is organized into four chapters. The first chapter looks at the emergence of the living lab methodology including its origin and attempts to define the living lab. Additionally, chapter one highlights key concepts from the literature such as Dekker et al.’s (2020) methodology and the “co-” paradigm. Chapter one provides an overview of the living lab methodology thus far and serves as the literature review for both empirical studies. Chapter two contains my first empirical study: a bibliometric analysis using the program VOSViewer to visualize the broad trends and applications of living labs in the literature over the past two decades. Chapter three contains my second empirical study: an analysis of a local application of the living lab methodology through a case study of the Lake Superior Living Labs Network (LSLLN). Finally, chapter four connects the two empirical studies to demonstrate how a real-world application of the living lab methodology aligns and diverges with the broad trends in the living lab literature. I

conclude my research by addressing the hidden role of the "co-" paradigm in the living lab methodology and stress the importance of being able to distinguish between different "co-" concepts. The results of my research contribute to the ongoing efforts made by scholars to clarify the conceptualization, methods, and applications of living labs. Living labs have significant potential to be a catalyst for social change but the true impact and value of living labs cannot be realized while shrouded in vague language and fragmented conceptualizations.

Reviewing the Living Labs Literature

Within the last decade, living labs have gained recognition as a new and innovative approach to address various complex social, environmental, and policy-related issues. Despite the recent attention, living labs as a methodology and a research setting have remained conceptually fuzzy. To gain a better understanding of this novel research approach and methodology, it is imperative to review the origin and various attempts to define living labs in the literature thus far. Furthermore, this literature review highlights key analyses and frameworks, such as the results from the Dekker et al's (2020) systematic literature review and the "Co-" paradigm, to contribute to the ongoing conceptualization of living labs.

The Origin of Living Labs

The living lab concept was first introduced in 1991 as a community operations research course at Drexel University in Philadelphia (Bajgier, 1991). The initial theoretical framework behind the living lab concept was Halmos's (1975) learning-through-doing approach; however, Bajgier et al. (1991) insists that the living lab concept goes far beyond this approach due to the complex nature of the issues that students were trying to solve in real-time with the community. The living lab course served as an introduction to real-life public policy issues in a local urban environment. Soon after, the living lab approach was adopted and developed further by Professor William J. Mitchell at MIT. According to Nesti (2018), Mitchell developed the living lab concept in 1995 as an innovative research approach incorporating new strategies and technologies to address modern social problems. While the living lab concept originated in universities in the United States, the movement gained traction in Europe during the

early 2000s. Foundational labs started in Finland, Sweden, the Netherlands, the UK, Brussels, and Spain (Leminen and Westerlund, 2019). The living lab movement gained significant attention in 2006 when Finland's Prime Minister introduced the Helsinki Manifesto to the European Union, resulting in the establishment of the European Network of Living Labs (ENOLL) (Leminen and Wusterland, 2019). The establishment of ENOLL helped put living labs on the map as a promising research and innovation method backed by government recognition. As of recently, ENOLL has identified over 460 living labs (LLs) in Europe and neighboring countries (ENOLL, n.d.). While Europe currently has the highest concentration of living labs, the geographic distribution of living labs continues to expand.

The living lab approach has made international waves, with labs popping up on nearly every continent. The LL approach has been tried and tested in places such as Australia, Egypt, Hong Kong, Japan, Mexico, Turkey, and Qatar (Amorim et al., 2022), just to name a few. Living labs present an appealing opportunity for innovation and governance, especially for developing countries looking to mitigate the impacts of climate change. From sustainability labs in Kenya (Ondiek & Moturi, 2019), to nature-based labs in Brazil (Amorim et al., 2022), the living lab approach is being embraced for its potential to aid in sustainable development. The growth of living labs internationally shows that many researchers and communities are eager to replicate the successes of European living labs. However, it is important to note that there is still a significant gap in international adoption. One bibliometric analysis of urban living labs found that the Global South represented just 5% of urban living lab case studies in the sustainability literature (Amorim et al., 2022). Seeing as living labs have only gained

momentum in the past two decades, it is understandable that international adoption and implementation are limited.

Key Discourse on the Conceptualization of Living Labs

Despite growing interest and widespread implementation, the conceptualization of living labs remains underdeveloped. The ambiguity of living labs makes it difficult to understand what exactly differentiates living labs from other research methods. Additionally, it makes it difficult to understand the boundaries of its application for solving real-world problems. Many attempts have been made in the literature to define living labs with fragmented conclusions. This analysis builds upon foundational concepts proposed by Dekker et al. (2020), however, it is important to acknowledge the other key studies contributing to the discourse on living labs.

Living labs have been described as many different things: an approach, a methodology, an organizational structure, or a physical experimental space (Dekker et al. 2020). Many of the existing descriptions are discipline specific—ignoring the diverse applications of living labs. One of the early definitions of living labs from Ballon et al. (2005) emphasizes the role of technology, suggesting that living labs are: "[an] experimentation environment in which technology is given shape in real-life contexts and in which (end)users are considered co-producers" (p. 3). This early definition makes sense, considering that many of the early applications of living labs were dedicated to the development and utilization of information communication technology (ICT). Følstad (2008) holds a similar view in his commonly cited definition:

> Living labs are environments for innovation and development where users are exposed to new ICT solutions in (semi)realistic contexts, as part of medium- or

> long-term studies targeting evaluation of new ICT solutions and discovery of innovation opportunities. (p. 116)

While these definitions are informative to the role of a specific lab or sector, ICT is not an integral component of all living labs. In fact, ICT was not even mentioned in the original living lab application at Drexel University.

Further prodding into the literature only reveals more inconsistencies. Some living labs are conceptualized by what they are doing, while others are conceptualized by who is contributing to this work. For example, the role of stakeholders is absent from the previous definitions but appears to be a central component in Molinari's (2011) definition:

> A LL [living lab] can be considered as a multi-stakeholder platform comprising different stakeholders, who perceive the same problem, realize their own respective interdependencies, and come together to agree on the best action strategies for solving it. (Qtd in Radulescu, p. 133)

Molinari's conceptualization of living labs clearly acknowledges the role of stakeholders, without explicitly identifying who can be considered as a stakeholder. Nevens et al. (2013) provide a more holistic description of living labs, highlighting who these potential stakeholders may be: "The concept of living labs serves as an explorative and user-centered space, combining research with innovation processes through a cooperation of the "public-private-people partnership," (qtd in Franz, p.115). This is much more of a holistic take on living labs, combining many of the characteristics from previously-cited definitions. Yet, this definition still falls short by failing to acknowledge the importance

of a real-life setting. Each attempt to define living labs illustrates just how fragmented the conceptualization of this research method is across disciplines.

Four Core Elements of Living Labs

With so many contrasting and incomplete definitions, it is easy to see why the broader conceptualization of living labs can be so difficult to grasp. However, one analysis in particular stands out for its strong definition of living labs. Dekker et al. (2020) conducted a qualitative meta-synthesis of 84 publications in the LL literature to gain a better understanding of the distinct characteristics and applications of living labs. Dekker et al. (2020) formally defined living labs as a "research and design methodology applied by research institutes in cooperation with public and private partners for developing and testing innovations in co-creation with users in real-life settings" (p. 1211). This definition stands out for two main reasons. First, Dekker et al.'s definition is broad enough to encompass the various applications of living labs, yet specific enough to set living labs apart as its own distinct research method. For example, living labs are a research and design that promote innovation but Dekker et al. do not identify what type of innovation. This open-ended definition allows users to adapt the living lab methodology to their field, such as ICT. Second, in Dekker et al.'s (2020) efforts to define living labs, four core elements commonly shared by living labs were identified:
(1) living labs utilize a research and development process of innovation; (2) living labs collaborate between multiple stakeholders; (3) living labs take place in a real-life setting, and (4) living labs involve users as co-creators. (p. 1210)

I argue that these four core elements are foundational to an accurate conceptualization of living labs. While Dekker et al.'s analysis was conducted to understand living labs in relation to public administration research, the four elements can be used to guide our understanding of applications of the living lab methodology in any field. The four elements identified in Dekker et al.'s work serve as important reference points in this bibliometric analysis. Therefore, further description of the core elements is needed.

The first core element identified by Dekker et al. (2020) is that living labs foster innovation through research and development processes. Research and development entails multiple stages and iterations of design, testing, and implementation. Innovation can be cultivated in various ways, from the research methods used to the services provided, or the end product provided. For example, Følstad's (2008) definition of living labs highlights innovation in a technological context through the exposure and implementation of new ICT solutions. Whereas Neven et al.'s (2013) definition emphasizes innovation as the process of engaging various perspectives in the public-private-people partnership. The specific type of innovation or research methods used appears to be dependent on individual labs' area of focus and end goals.

Second, Dekker et al. (2020) highlight collaboration between multiple stakeholders as a core element shared by living labs. Living labs are not contained within a single institution. Instead, living labs are composed of multiple stakeholders offering diverse perspectives, areas of expertise, and resources. Dekker et al. (2020) note that stakeholders can range from universities, businesses, governments, and NGOs. In other words, living labs are often thought to engage in collaboration through the Triple Helix model or even better, the Quadruple Helix model. The Triple Helix model encourages

innovation through the engagement of three stakeholder groups: academia, industry, and government (Etzkowitz and Leydesdorff, 2000; Nguyen and Marques 2022). The Quadruple Helix model seeks to enhance the previous model by closing the gap between the Triple Helix and civil society (Nguyen and Marques, 2022). Therefore, civil society or public participants can be seen as a fourth stakeholder in the living lab methodology.

The physical setting of living labs is another core element of living labs. Dekker et al. (2020) note that contrary to their names, living labs are not sterile isolated environments typical of research laboratories. Instead, living labs are deeply integrated into the physical environment in which they are situated. According to Dekker et al. (2020), a real-life setting is critical to the living lab methodology because "innovations are developed to fit the specific local context" (p. 1211). The scope of setting appears to vary, from living lab networks that span regions to individual labs set in a local place such as a library or hospital.

Finally, Dekker et al. (2020) found an essential element across all living labs is that users are involved as co-creators. User involvement is highly encouraged in the living lab methodology because of the perspectives that they can offer as the people utilizing the service or end product produced by living labs. The concept of 'users as co-creators' is an especially important core element of living labs. Co-creation among users is deeply intertwined with the first three elements identified by Dekker et al. (2020). Take the first element–innovation–for example: considered as its own form of innovation, users as co-creators is also referred to as 'user-driven' innovation (cf. De Moor et al., 2010a; Dekker et al. 2020). By including users as co-creators in the design process, researchers are already implementing a research and development process that is

innovative. Second, as mentioned with the Quadruple Helix model, users can also serve as important stakeholders. Finally, users as co-creators directly correlate to a real-life setting by collaborating with people situated in the local living lab setting. Therefore, users as co-creators are integral to the conceptualization of living labs.

What started as an unconventional college course at Drexel University has blossomed into an international movement with significant potential to address a variety of pressing societal issues. The emergence of living labs has brought forth new possibilities, pushing the boundaries of traditional research and development approaches. However, the inconsistency in the literature thus far makes it clear that we are still in the beginning stages of understanding what exactly the boundaries of living labs are. The four core elements of living labs identified by Dekker et al. (2020) provide the foundation for building a credible and clear definition of living labs. These four core elements provide criteria for researchers to evaluate ongoing attempts to conceptualize living labs.

Connections to the "Co-" Paradigm

Taking it one step further, this analysis seeks to connect the "co-" paradigm to the conceptualization of living labs. The "co-" paradigm has gained recognition from scholars in Public Administration literature as a contemporary approach to public policy issues. As the prefix "co-" represents togetherness, the co-paradigm attempts to encapsulate all of the broad ways in which public policies, programs, and knowledge can be created through collaborative efforts. The "co-" paradigm also includes co-creation, co-design, and co-production which are often used to describe various collaborative approaches in public sector services (Schwoerer et al. 2022). The "co-" paradigm expands upon the fourth core element identified by Dekker et al. (2020) which states that

users are involved throughout the research and design process as co-creators. Co-creation is noted as an integral component of living labs in the majority of the literature. For example, Hagy et al. (2016) highlight that living labs rely heavily on transdisciplinary social learning through the co-creation methodology, where knowledge is generated in an ongoing interactive process between academia, business, and society.

However, co-creation is just one method that falls under the wider umbrella of the "co-" paradigm. There is evidence to suggest that the living lab methodology engages in various aspects of the "co-" paradigm, not just co-creation. The specific types of collaboration and "co-" may vary from lab to lab, with some living labs placing an emphasis on co-design over co-creation or vice versa. As living labs have been adapted to many different fields and issues, it follows that there would be variation in the different types of "co-" that are applied by living labs. Regardless of the specific type, the persistence of co-creation, co-production, and co-design in the living labs literature suggests that the co-paradigm is an important framework for understanding the involvement of civil society in living labs. Therefore, it is pertinent to define the different aspects of the "co-" paradigm to better understand how each one of these distinct concepts are represented within the literature on living labs.

The "Co-" paradigm is composed of three main concepts: co-creation, co-design, and co-production. The "co-" concepts are often intertwined and overlapping. Similar to living labs, the "co-" paradigm also suffers from conceptual ambiguity and misrepresentation. However, there are steady efforts in the public administration effort to distinguish the different types of "co-" and the role they play in the creation of public services. While each "co-" concept adds another layer to living labs, the broader

conceptualization of living labs can stand to benefit from removing vague language that contributing to generalizability. Furthermore, distinguishing between each "co-" paradigm concept is important in the context of living labs because it can provide insight into which stage of the process users are most likely to be engaged.

Demystifying the "Co-" paradigm begins with an accurate description of co-creation. Co-creation is perhaps the most easily misused concept under the "co-" paradigm, often acting as a catch-all term for any form of civic or user collaboration. However, according to Branden, Steen, and Verschuere (2015) co-creation differs from its counterparts by the timing and role of collaboration:

> Co-production is generally associated with services citizens receive during the implementation phase of the production cycle, whereas co-creation concerns services at a strategic level. In other words, when citizens are involved in the general planning of a service —perhaps even initiating it — then this is co-creation, whereas if they shape the service during later phases of the cycle it is co-production. (p. 13)

Therefore, co-creation can be understood as engaging users at the beginning of the research and development process. Co-creation is not something that happens continually through the innovation process, nor is it something emergent through the process, despite it often being referred to throughout all phases of living labs. Co-creation is an intentional act to include users in the beginning stages of planning.

Co-design comes in as an intermediary step between co-creation and co-production, using the momentum from co-creation to craft solutions implemented through co-production. As implied by the name, co-design brings in users during the

design process. Co-design serves as a bottom-up approach challenging the norm of expertise and evidence-based research designs (Dudau et al., 2019). Citizens or users can engage in the design or planning process in a variety of ways, yielding different design plans and outputs. In the public administration literature, design processes and outputs can be considered any of the following: “a policy instrument, program, plan, service, or a new and innovative approach to management, service delivery or theory,” (Schwoerer et al. 2022, p. 5). Co-design can be implemented in living labs through smart cities, urban governance, or even technology design.

The final concept under the “Co-” paradigm is co-production. Co-production overlaps with co-design but is primarily concerned with the services citizens receive during the implementation phase of the production cycle (Brandsen et al., 2018). Otherwise, co-production can be thought of as the service, policy, or object that has been produced as the result of co-creation and co-design. Co-production can also be understood as the value and knowledge that has been produced through the living lab methodology. Discussing the nuances behind the different concepts that comprise the “co-” paradigm may seem trivial but it is necessary to elucidate how living labs engage and collaborate with civil society to produce tangible change.

Conclusions

The living lab proves to be an interesting phenomenon. The growth and widespread use of the methodology clearly suggests interest and benefits. Yet, somehow a clear and consistent definition has failed to materialize in the first two decades of the living lab approach. Living labs have undergone many different iterations, dabbling in nearly every discipline. This has made it difficult to ascertain the true nature of the living

lab methodology and thus the true value and scope. Dekker et al.'s analysis of living labs provides one of the most comprehensive definitions of living labs to date by identifying four core elements. These four core elements are broad enough to be applied to various disciplines, while specific enough to place boundaries on the emerging methodology. The addition of the "co-" paradigm (Schwoerer et al. 2022, Brandsen et al., 2018) offers context to understand one of the fundamental elements of living labs in depth. The role of the "co-" paradigm in living labs can illustrate how and when living labs engage with civil society to collaborate on contemporary issues.

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Visualizing the Conceptualization and Application of Living Labs: A Bibliometric Analysis using VOSviewer

Introduction

As a relatively new phenomenon, it is interesting to study the development of living labs as a research method actively engaged in a wide range of scientific and social disciplines. Furthermore, the global reach that living labs have is quite impressive. Living labs have been quietly proliferating across European countries and continue to expand on the home front, as well as in African and South/Latin American countries. The wide range of disciplines and international reach of living labs have begun to pique scholarly interest. Despite all of this, the current conceptualization of living labs is incomplete, with the literature failing to provide a uniform definition to guide this methodology and its various applications. In an effort to better understand living labs as an up-and-coming research method, I conducted a bibliometric analysis of the living lab literature over the last two decades. This method allowed me to examine the evolving conceptualization and applications of living labs. As highlighted by Donthu et al. (2021): "Bibliometric analysis is especially useful for deciphering and mapping the cumulative scientific knowledge and evolutionary nuances of well-established fields by making sense of large volumes of unstructured data in rigorous ways" (p. 285). The bibliometric analysis was particularly useful in this case because it allowed me to adjust or remove the temporal and spatial limitations that many research methods are often bound by. Using a carefully constructed

and well-documented Boolean search strategy, these results can be replicated by other researchers and applied in the future to examine ongoing changes.

Methodology

The wide-ranging applications and fluid organizational structures have made understanding the boundaries and implications of living labs difficult. Many research fields stand to benefit from the development of a definitive methodology with clear applications, shifting living labs from a buzzword to a credible research method for innovation and social change. Therefore, it is critical to analyze the wide-ranging discourse that surrounds living labs. One method particularly suited for this type of research is bibliometric analysis. Bibliometric analysis is a valuable tool used by scholars to identify emerging trends and patterns in large volumes of literature concentrated on an area of interest. Bibliometric studies can produce important research implications, especially in developing fields. Donthu et al. (2021) highlight such implications:

> Bibliometric studies that are well done can build firm foundations for advancing a field in novel and meaningful ways — it enables and empowers scholars to (1) gain a one-stop overview, (2) identify knowledge gaps, (3) derive novel ideas for investigation, and (4) position their intended contributions to the field. (p. 285)

In this case, a bibliometric analysis is useful to identify the broad conceptualization of living labs and reduce further ambiguity on the subject.

Software programs such as VOSviewer can further enhance the results of bibliometric studies. VOSviewer is considered a bibliometric analysis enrichment technique (Donthu et al., 2021), creating accessible and informative visualization

networks from bibliometric data. VOSViewer software constructs networks with bibliographic data such as citations or key terms using the VOS mapping technique, where VOS stands for visualization of similarities (Van Eck and Waltman, 2009). Therefore, VOSviewer can illustrate commonly referenced topics or authors in large quantities of data through colorful networks and clusters. This is achieved through a text-mining functionality that extracts co-occurring terms from a body of scientific literature. So not only does VOSviewer map and visualize each term by the volume of occurrence but also the relationship of terms as they co-occur with one another. The multiple visualization features offered by VOSviewer make it easy to identify patterns and trends in the literature over time. Vosviewer is an underutilized tool that can contribute to the ongoing discourse on the conceptualization of living labs.

Boolean Search Strategy

The bibliometric network on living labs was constructed using the bibliometric analysis software VOSviewer and data was methodologically chosen from the abstract and citation database Scopus. Figure 1 highlights the Boolean search strategy employed to identify relevant literature on living labs. The broad search started with just “living lab” and publication dates ranging from 1999 to the present (2023). The initial search resulted in a total of 2,379 documents. Then I refined the search to be more specific. Living labs are often described alongside policy innovation labs (PILS). Therefore, I added the term “policy” in addition to “living lab” to try to gain a better understanding of the relationship between these two concepts in the literature. This resulted in 276 documents. The choice to search for “living lab” AND “policy” instead of OR was critical because the goal is to understand the relationship or overlap between the two. OR

would have created more results, but taken away the focus from living labs. In an effort to increase the number of documents related to living labs and policy innovation labs, I added the term "innovation" to the mix. The term "innovation" was added on the condition OR, because this would maintain the current presence of policy labs or policy productions identified, but also add in the potential for innovation labs, as well as search for one of the key pillars of living labs. This increased the search result to 967 documents.

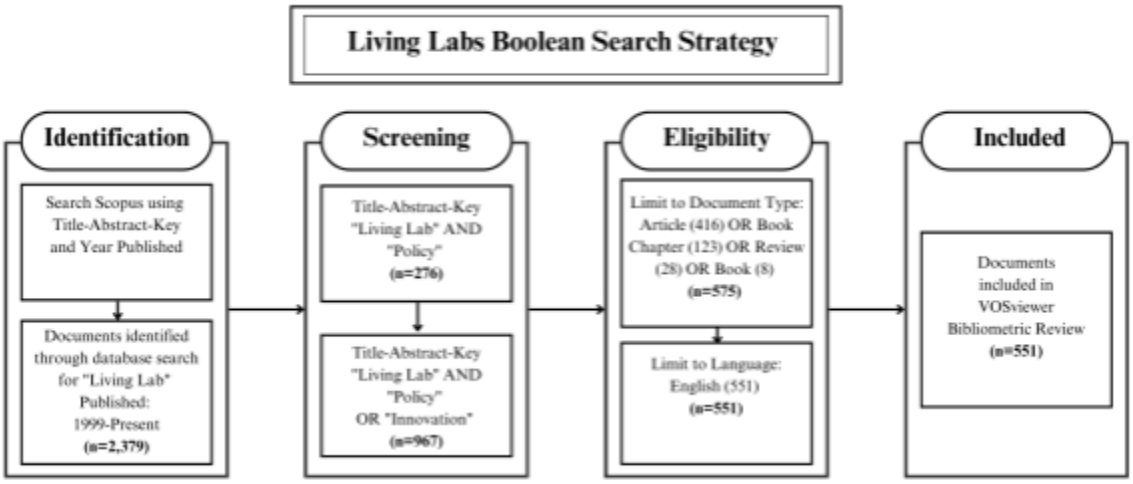

Figure 1.

Living Labs Boolean Search Strategy

From here, it was important to determine which types of documents were eligible for analysis. I limited eligible document types to articles, book chapters, books, or reviews. As the conceptualization of living labs is new and frequently evolving, I wanted to base my analysis on peer reviewed articles and substantial published sources. While

conference papers or theses are interesting, I wanted to include the most developed sources within the literature. Additionally, I limited eligible documents to English only. I acknowledge that this limits international perspectives on living labs, but this was necessary because I could not risk skewing the data set used to create my bibliometric analysis with inaccurate keyword translations. The final number of documents downloaded for the bibliometric analysis was 551.

VOSviewer Network Strategy

There are many different parameters to make note of when creating a bibliometric network using VOSviewer. The alteration of a single parameter can result in an entirely different network. Therefore, it is essential to note the exact process for replication purposes. Figure 2 highlights the entire process and specific parameters chosen to create the final VOSviewer bibliometric networks featured in this paper.

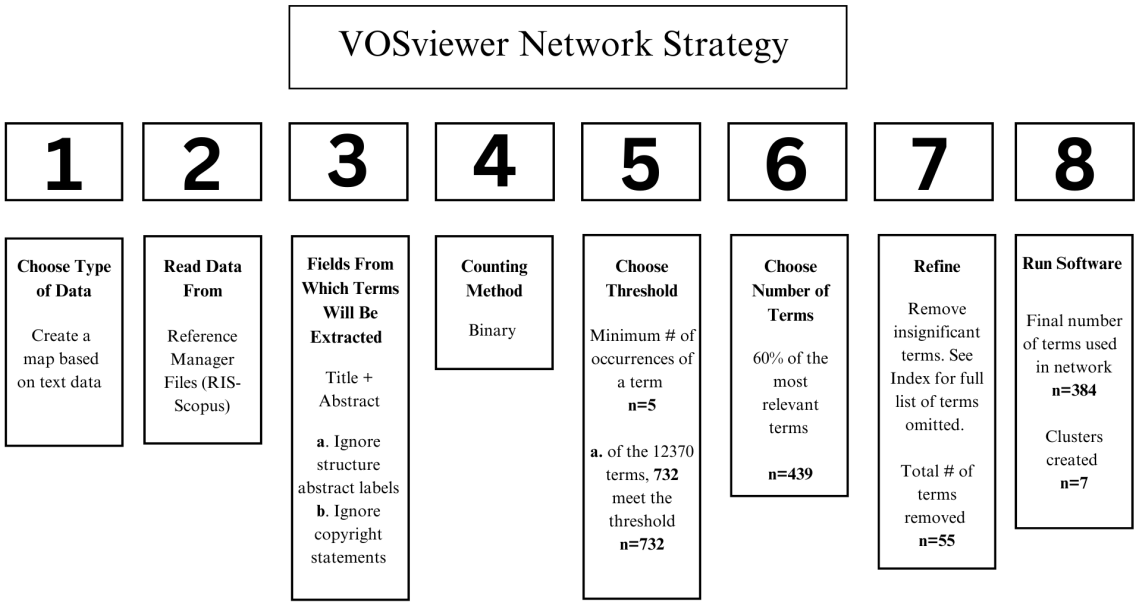

Figure 2

VOSviewer Network Strategy

The first step in creating a bibliometric network in VOSviewer is to decide what type of data to use. In this case, the bibliometric network created used text data. The text data was acquired and read from the 552 documents downloaded from the Scopus database in the form of a RIS (research information systems) file. The next step is to determine which field terms will be extracted from. I extracted terms from the titles and abstract. I ignored structure abstract labels as well as copyright statements because these could provide repetitive or irrelevant language. In step 4, users decide between a binary counting method or a full counting method. A binary counting method only takes into account the presence or absence of a term within a single document, while full counting means that all occurrences of a term within a document are counted. This analysis is interested in the broad characterization and application of living labs across different fields. Therefore, it

makes sense to use binary counting to analyze the occurrence of terms across all documents, instead of full counting which could inflate the significance of some terms just because a particular author has an affinity for using it often.

Another key step is to choose the threshold of how many times a term should be counted to be considered significant. Of course, the higher the minimum amount of occurrences of a term will lead to significant results. However, this needs to be balanced with the overall number of terms that are eligible for analysis. Due to the relatively small number of papers (551), the minimum occurrence of a term needed to be slightly lower to draw out significant connections between networks. In past tests, a higher minimum occurrence of terms resulted in a lower threshold creating sparse networks. Therefore, I determined that the minimum number of occurrences for a term would be 5. From this, 732 terms met the threshold. To narrow this number down even further, I selected only 60% of the most relevant terms, leaving 439 documents.

The last step, and perhaps the most important step, is to refine the remaining terms by removing irrelevant or insignificant terms one by one. I removed terms based on four conditions: (1) references to time, (2) measurements, (3) terms used to describe the structure of articles, and (4) terms that lacked context. Terms that were descriptive or referenced time such as ‘first time,’ ‘beginning,’ ‘month,’ ‘year,’ etc. were excluded because more accurate temporal data can be derived from publication dates. Following that, terms that reference a type of measurement such as ‘increase,’ ‘decrease,’ ‘range,’ and ‘reduction,’ were excluded because these terms alone cannot tell us what is being measured. Additionally, terms commonly used to describe general aspects of research articles and publications were removed. These terms do not relate to the actual content of

the articles, but just the outline of what shapes them. Examples of this include ‘main contribution,’ ‘main finding,’ ‘overview,’ ‘systemic literature review,’ and more. Finally, terms were removed if they lacked context to provide meaningful insight. Examples of this include ‘attempt,’ ‘line,’ ‘lot,’ ‘hand,’ ‘regard,’ ‘thing,’ etc. The full list of terms removed during the refining process is available in Appendix A, Table A. In total, 55 terms were removed, leaving 384 terms to be analyzed and applied to the final network creating seven distinct clusters.

Results

In this section, I will illustrate the results of my bibliometric analysis using three key features in VOSviewer. VOSviewer maps comprehensive bibliometric networks using three different visualization features: density visualization, overlay visualization, and co-occurrence network visualization. Each feature illustrates different factors such as density, time, and connectivity. Mapping these different factors can enhance our understanding of the emergence, characterization, and application of living labs over the last two decades.

Density Visualization

The density visualization feature illustrates how many times a term or phrase has occurred throughout all of the abstracts and titles of literature downloaded from Scopus. Similar to a heat map, red indicates the highest density of occurrences while green and light blue indicate the lowest density. The density visualization feature offers a simple overview of what can be considered hot topics or key terms. Figure 3 highlights commonly occurring terms in the living labs literature using the density visualization feature. The highest-density terms appear to be ‘design methodology approach,’ ‘site,’

‘governance,’ ‘urban living lab,’ ‘ull’ (urban living lab), ‘education,’ ‘access,’ and ‘end user.’

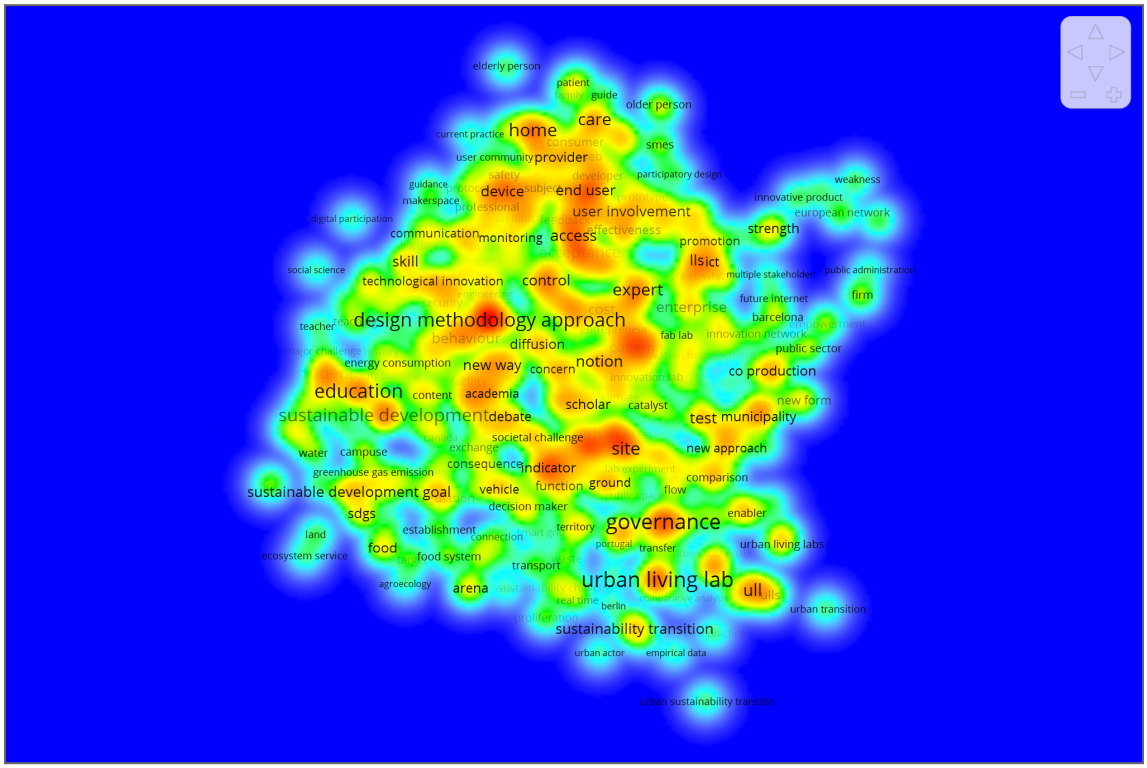

Figure 3

VOSViewer Density Visualization Feature

Overlay Visualization: Temporal Distribution

The overlay visualization feature uses different colors to highlight how key terms in the literature are distributed over time. Figure 4 highlights how the occurrence of terms varies in density from 2017 to 2023. The spectrum of colors used to represent the publication year is laid out in the key at the bottom right corner. At first glance, the majority of terms were cited between 2017 and 2018 as represented by the dark blue and

purple nodes. During 2020-2021, terms such as ‘education,’ ‘governance,’and ‘urban living lab’ started to emerge. Finally, the most recently published literature from 2022 and on occupies a small space as depicted by the yellow nodes. According to this network, the most recent developments in the literature are related to sustainable development goals (SDGs).

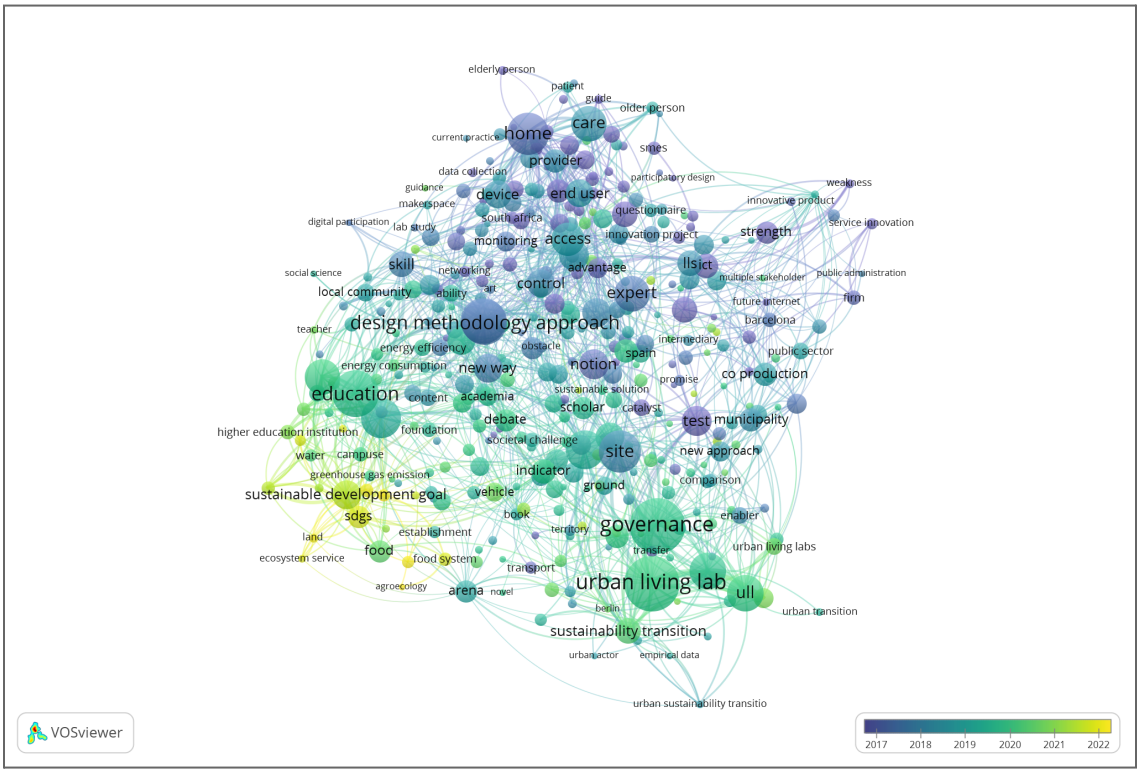

Figure 4

VOSviewer Overlay Visualization Feature

Co-Occurrence Network Visualization

While the density visualization feature illustrates the number of times a term or phrase has occurred, it fails to show how these terms relate to one another. The

co-occurrence network visualization in Figure 5 highlights the significance of terms independently as well as in relation to one another. In a co-occurrence network visualization, the density of each independent term is illustrated not by color like in Figure 1, but by the size of the nodes. The larger the node, the higher the occurrence of that term throughout the literature. Now, the relationship between these terms can be described as links or connectivity. The more times that terms occur together, the stronger their connection will be within the network.

In a co-occurrence network, connectivity is visualized in two main ways: clusters and lines. First, clusters are composed of terms (nodes) with high connectivity. Terms that frequently occur together cluster together in one distinct color, making it easy to identify patterns and trends. However, a node is not bound solely to its own cluster. A node can link to other nodes outside of its cluster if terms are mentioned together more than twice. Second, the lines between nodes represent links. Links show what terms are cited together and how many times. The thickness of a line represents the strength of the link between two terms. Connectivity is a vital part of network visualization because it highlights distinct trends in the language used to describe living labs. Furthermore, it illustrates relationships or boundaries between terms and topics that might otherwise be overlooked by just measuring the density of terms.

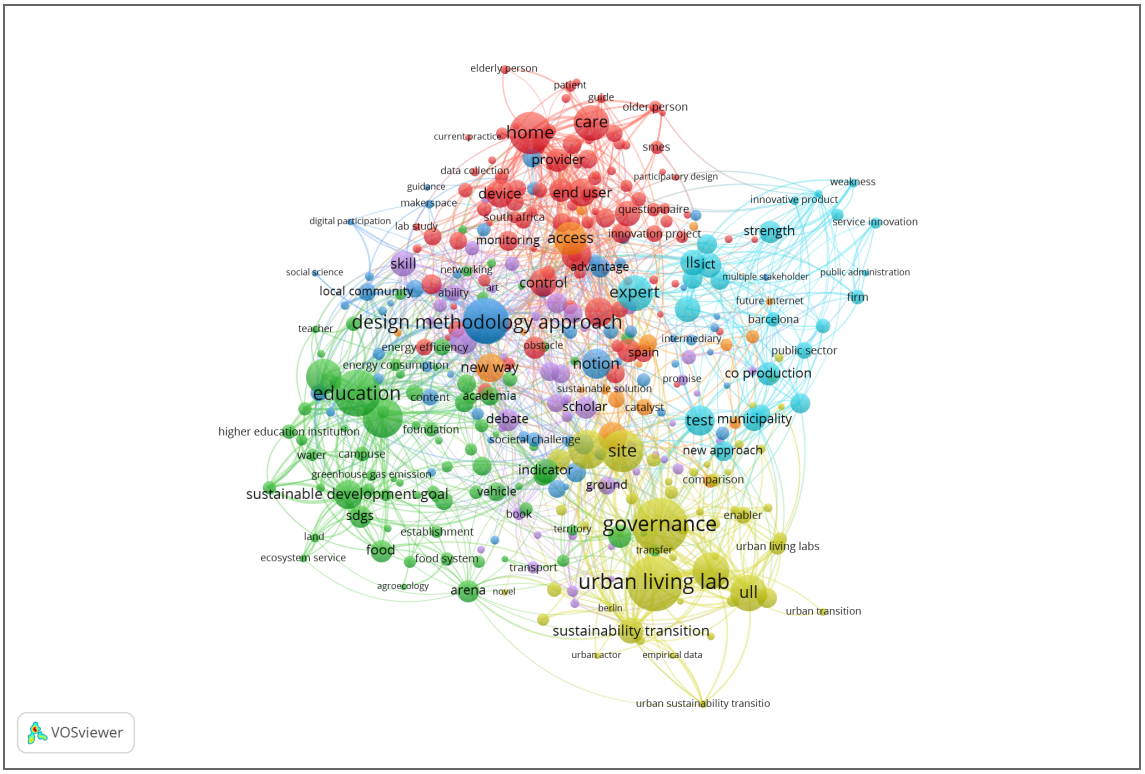

Figure 5

VOSviewer Co-occurrence Network Visualization Feature

The Elements of Living Labs in the Literature

After careful consideration and the implementation of specific parameters (found in the methods section), I derived 384 items from the body of literature on living labs downloaded from Scopus to create the VOSviewer network visualization in Figure 5. This network features seven distinct clusters, which are described in Table 1.

Table 1

Elements of Living Labs VOSviewer

Elements of Living Labs VOSviewer				
Cluster	**Color**	**Total Number of Terms**	**Commonly Occurring Terms**	**Description**
No. 1	Red	101	Home, care, acceptance, end user, user involvement, healthcare, communication	Focuses primarily on user engagement and experiences in the healthcare field. Home-based healthcare practices and solutions.
No. 2	Green	77	Education, sustainable development, student, sustainable development goal, food, higher education institution (hei)	Living Labs as a pillar of research and education in higher learning institutions (hei), with an emphasis on environmental issues and sustainability
No. 3	Blue	58	Design methodology approach, notion, conceptual framework, innovation lab, research project, societal challenge, transdisciplinary approach, local community, living labs approach	Academia based. Conceptualizing and understanding living labs as a framework and methodology.
No. 4	Yellow	53	Urban living lab, governance, neighbourhood, citizen engagement, collaborative process, urban governance, urban planning, district	The application of living labs in urban settings. Heavily focused on place-based language.

Elements of Living Labs VOSviewer				
No. 5	Purple	52	Behaviour, communication technology, debate, innovation management, scholar, skill, smart city, smart living lab (sll), entrepreneurship	Highlights a variety of living lab applications; behaviour economics, technology, business, etc.
No. 6	Aqua	24	Expert, co-production, creativity, empowerment, public administration, public sector, service innovation, new form, information communication technology (ICT)	Highlights the collaborative aspects of living labs through co-production, public sector innovation, and engagement with experts and the community.
No. 7	Orange	19	Access, new way, urban area, inclusion, catalyst, innovation network, sustainable solution, innovation approach, collaborative approach	Innovation as an approach that is open, accessible, and inclusive.

Cluster 1: User Experiences in Healthcare. In this paper, clusters are organized by the total number of terms within a cluster from highest to lowest. Therefore, cluster 1 (red) leads with a total of 101 terms. Figure 6 highlights the highest occurring term in cluster 1 ‘Home’. Home is linked to a term from every single cluster, with 146 links in total. However, it seems to have the most links in common with cluster 5 (purple). Significant terms in cluster 1 include ‘home,’ ‘care,’ ‘acceptance,’ ‘end-user involvement,’ ‘healthcare,’ and ‘communication.’ Therefore, this cluster closely aligns with the literature published on user engagement involving the healthcare field and home-based healthcare practices and solutions, with special attention to elderly patients with dementia.

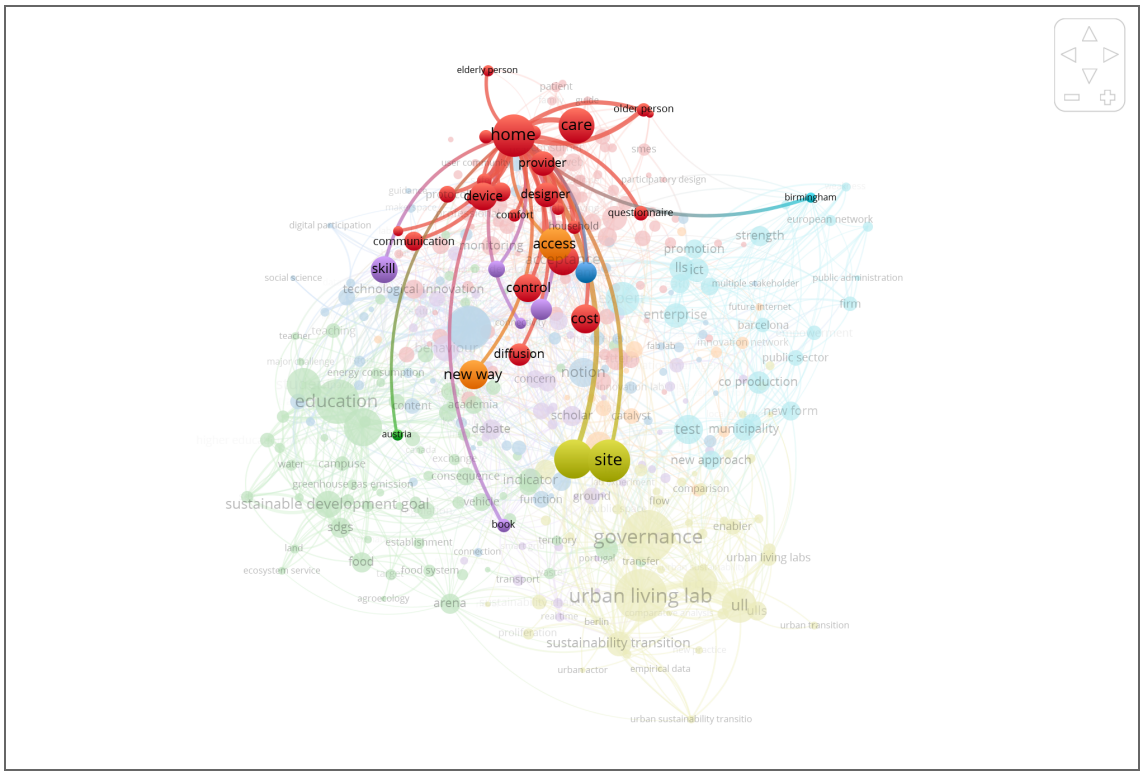

Figure 6

Cluster 1: User Experiences in Healthcare

Cluster 2: Higher Education Institutions and Sustainable Development. Cluster 2 (green) contains the second-highest amount of terms, totaling 77. Education is the highest occurring term in cluster 2, with its strongest links highlighted below in Figure 7. Education is linked to at least one term from every other cluster, with a total of 180 links. Terms that are closely linked with education in cluster 2 focus on topics of sustainability and environmentalism. It is important to note that sustainability could have a larger impact if it was not separated by acronyms such as SDG, SDGs, sustainable development goal, etc.

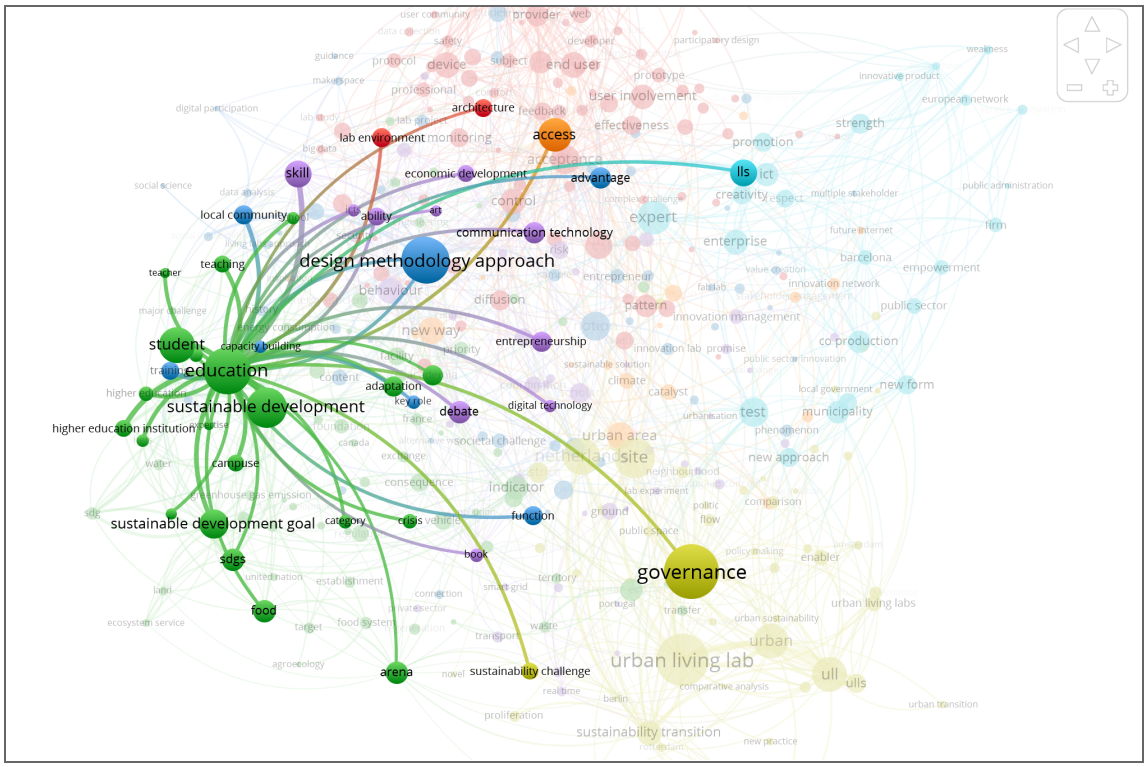

Figure 7

Cluster 2: Higher Education Institutions and Sustainable Development

Cluster 3: Conceptualization of Living Labs as a Research Methodology. The third cluster (blue) focuses on the conceptualization of living labs as a framework and methodology. Many of the terms in cluster 3 relate back to the four pillars of living labs as defined by Dekker et al. (2020). Figure 8 highlights 'design methodology approach' as the highest occurring term with 33 occurrences and 153 links. Design methodology approach is strongly linked to cluster 2, co-occurring with terms related to education and sustainability.

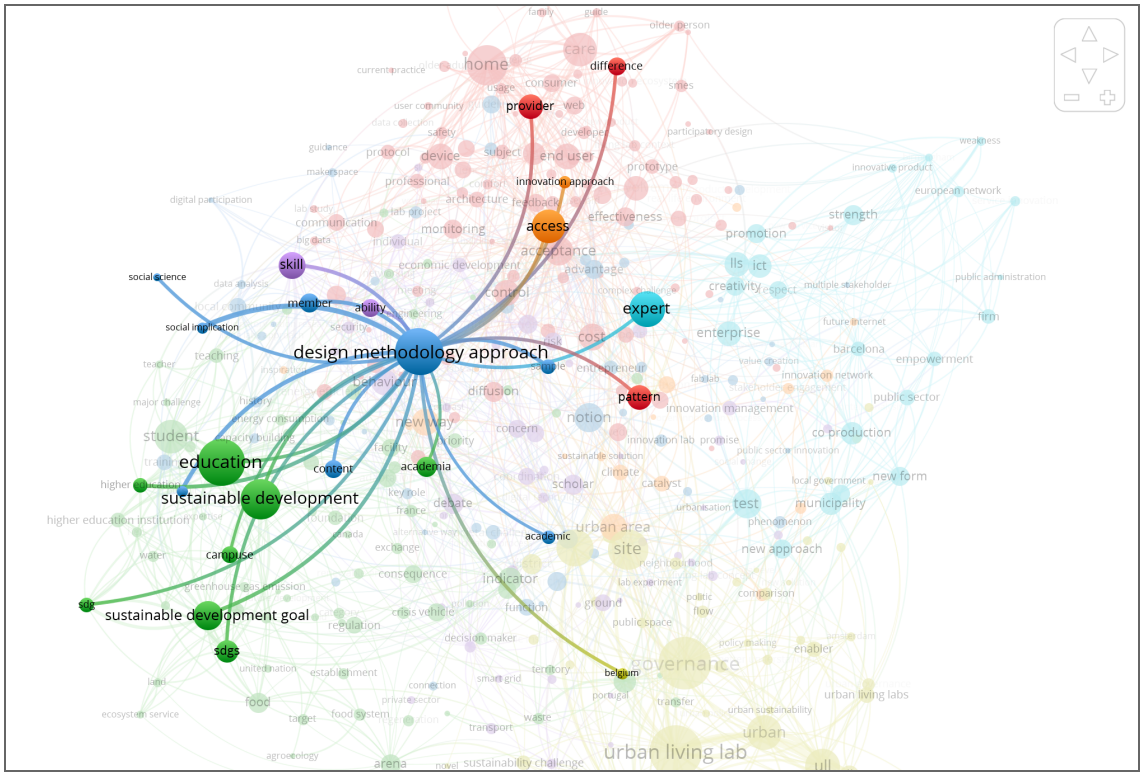

Figure 8

Cluster 3: Conceptualization of Living Labs as a Research Methodology

Cluster 4: Urban Living Labs. Cluster 4 (yellow) is unique in that there are two terms tied for the highest occurrence. The terms governance and urban living lab both occur 40 times. Cluster 4 provides valuable insight into real-world applications and settings of living labs. In the literature, an urban living lab or ULL has emerged as a term worthy of distinction separate from the general description of living labs. Figure 9 demonstrates that the term ‘urban’ is used throughout cluster 4, highlighting that an urban setting and urban issues are noteworthy topics of discussion for living labs.

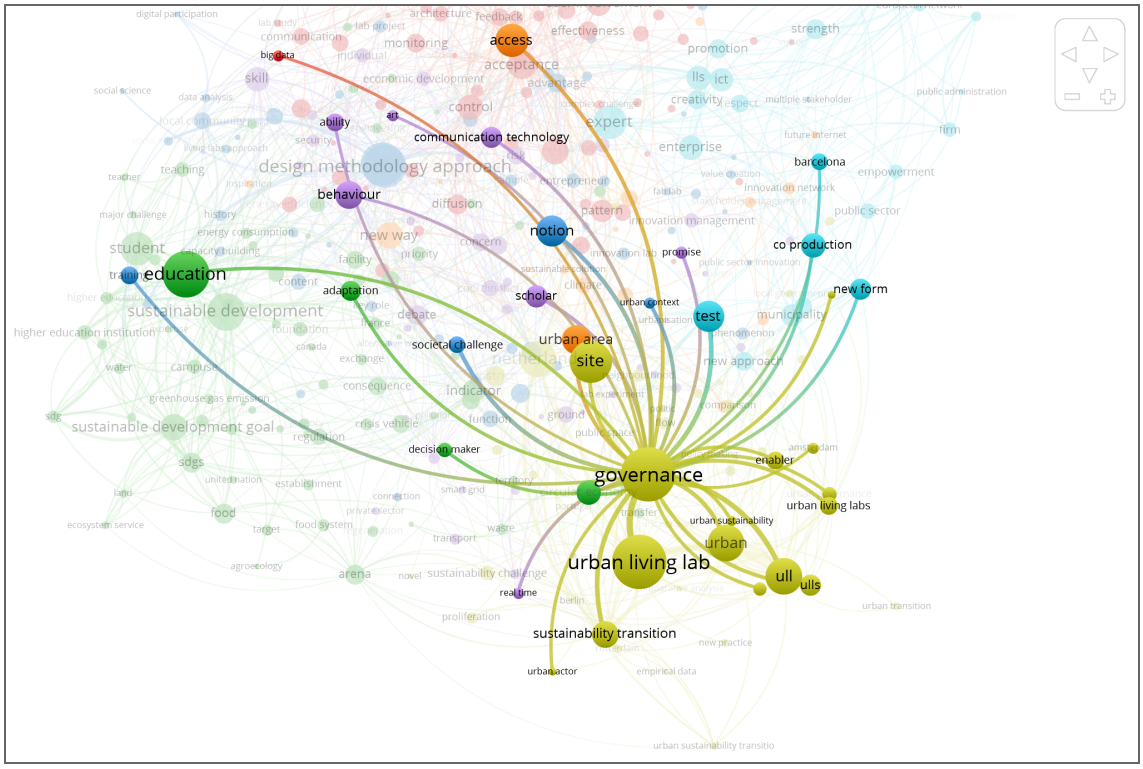

Figure 9

Cluster 4: Urban Living Labs

Meanwhile, Figure 10 illustrates the term ‘governance’ is of equal importance in cluster 4 and is linked strongly to urban living labs as well as many other clusters. Governance is linked to ‘education,’ ‘behaviour,' ‘access,’ ‘co-production,’ ‘adaptation,’ ‘decision maker,’ ‘societal challenge,’ and more. The interest in governance complements some of the elements outlined by Dekker et al. (2020), such as collaboration between multiple stakeholders and involving users as co-creators.

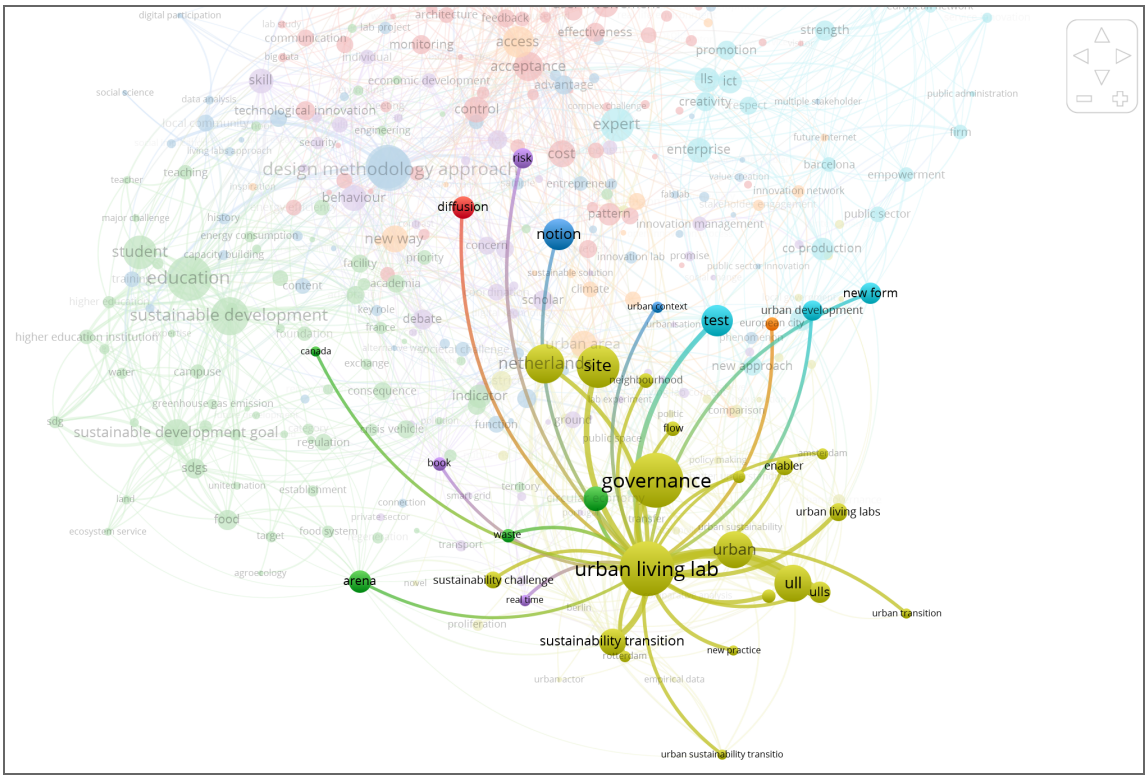

Figure 10

Cluster 4: Governance

Cluster 5: Living Labs Applied: Behavior, Business, and Technology. Cluster 5 (purple) highlights another niche application for living labs. Figure 11 illustrates cluster 5 with the highest occurring term ‘behaviour’. It is important to draw attention to the spelling of behaviour, which is the British spelling. This is a significant clue to where behaviour labs are taking place. Other significant terms include: ‘citizen participation,’ ‘communication technology,’ ‘citizen participation,’ ‘ict’ (information communication technology), ‘smart city initiative,’ ‘economic development,’ and ‘digital technology.’ This cluster suggests that living labs are working to address societal issues through user behaviour and technological innovations.

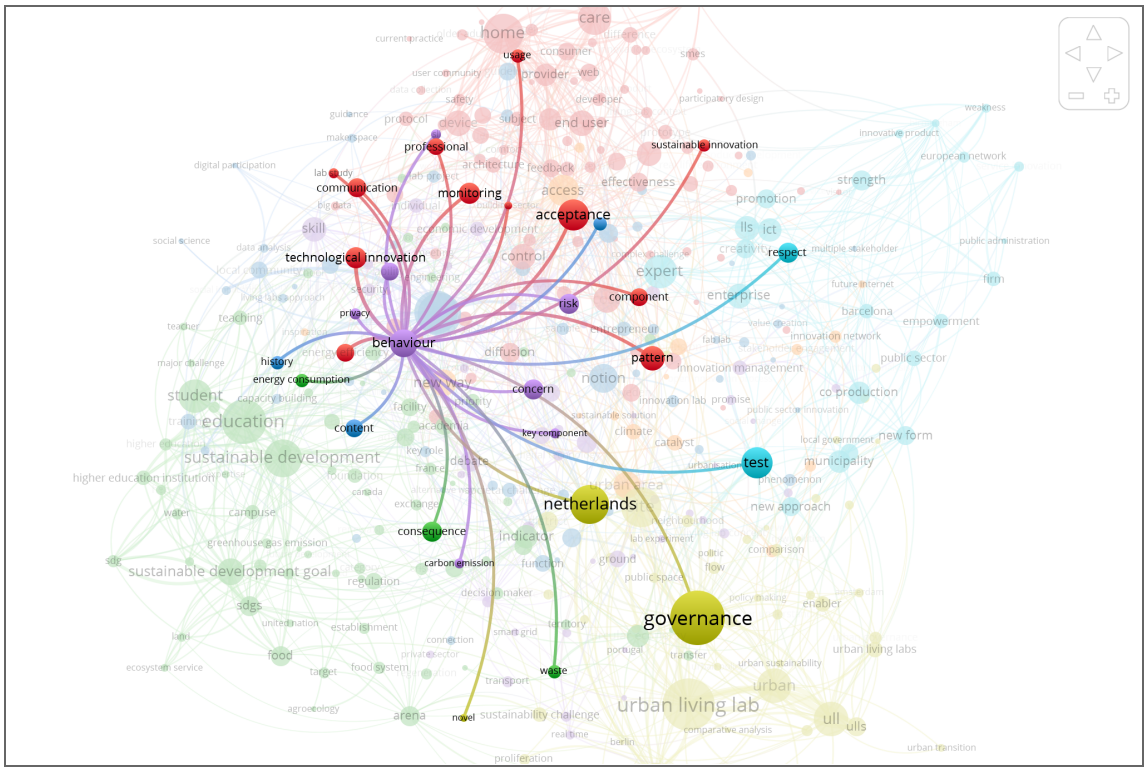

Figure 11

Cluster 5: Living Labs Applied: Behavior, Business, and Technology

Cluster 6: Collaboration in Living Labs. The central theme in cluster 6 (aqua) is not immediately obvious. Figure 12 highlights the term with the highest number of occurrences in cluster 6.. The term expert is most strongly linked to terms within its own cluster. While the highest occurring term in each cluster provides strong context to the cluster's overall theme, 'expert' does not necessarily illustrate the variety that can be found within cluster 6. Therefore, it is important to take into account the common thread between all of the terms in cluster 6 and not just summarize based on density. Cluster 6 includes the terms 'co-production,' 'creativity,' 'empowerment,' 'enterprise,' 'lls' (living labs), 'new approach,' 'new form,' 'public administration,' 'public sector,' 'municipality,' 'service

innovation,' and more. In addition to 'expert' these terms highlight different stakeholders and a collaborative aspect.

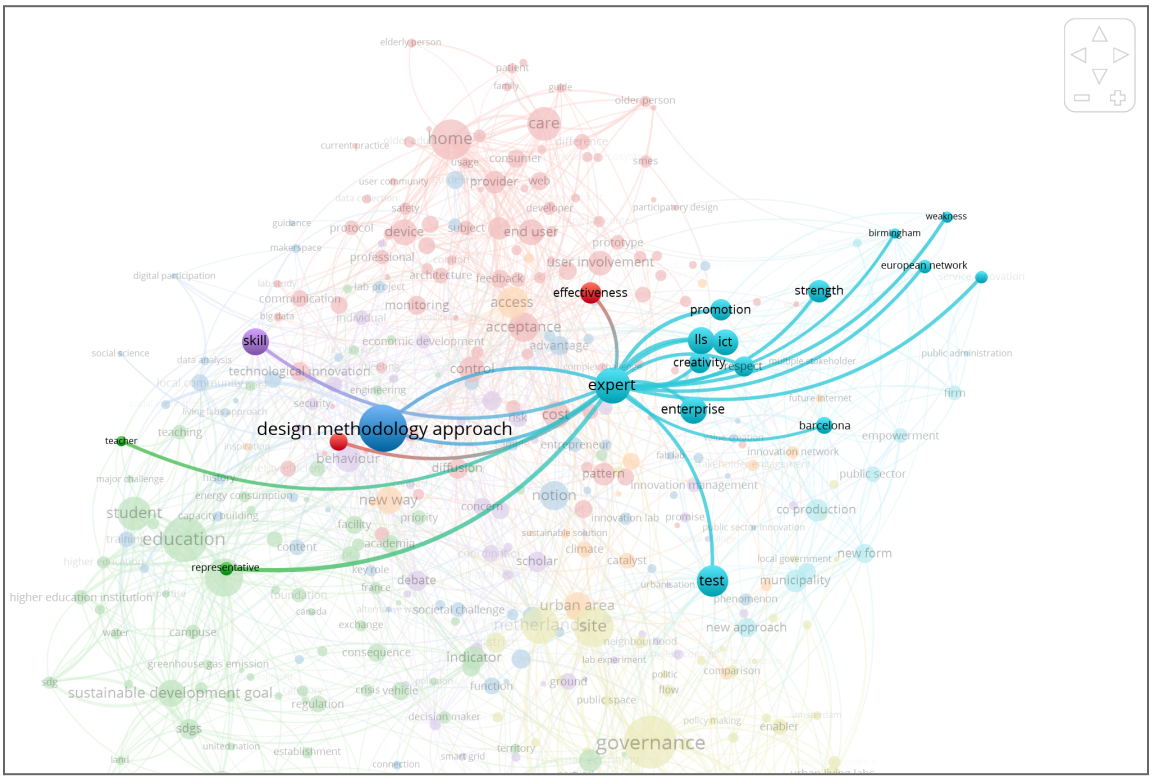

Figure 12

Cluster 6: Collaboration in Living Labs

Cluster 7: Incorporating Innovative Approaches. Finally, the network is completed by cluster 7 (orange). Cluster 7 is centered around the term 'access' as highlighted in Figure 13. The term 'access' is linked to every single cluster in the network. Access can refer to many different things such as open access to information, design access, and more. Other significant terms in cluster 7 include 'new way,' 'urban area,' 'inclusion,' 'catalyst,' 'innovation network,' 'sustainable

solution,' 'innovation approach,' and 'collaborative approach.' This cluster highlights some of the fundamental terms used to describe living labs.

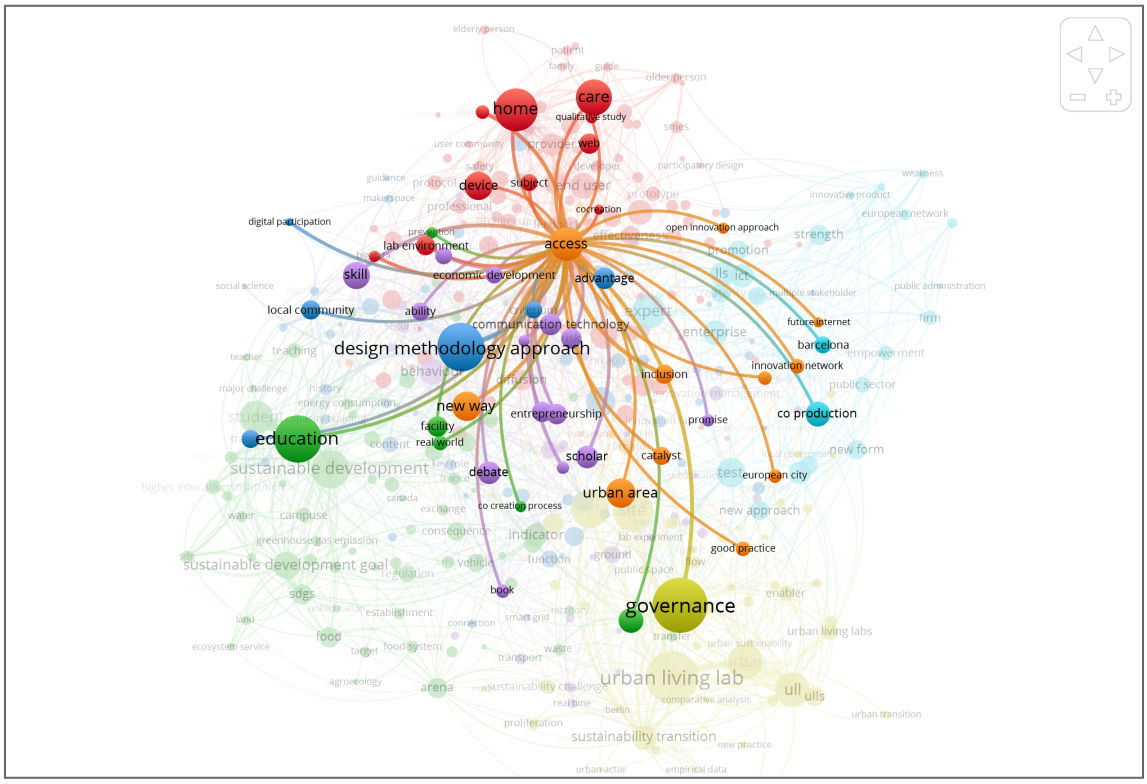

Figure 13

Cluster 7: Incorporating Innovative Approaches

Discussion

A few conclusions can be drawn from the three different VOSviewer networks about the broad conceptualization and application of living labs. First, the density visualization feature serves as a preliminary glimpse into popular topics and terms mentioned in the living labs literature. This highlights popular topics frequently discussed within the living lab literature. The terms 'design methodology approach,' 'governance,'

‘urban living lab,’ and ‘end user’ provide insight into the living lab methodology and a prominent application. Second, the overlay visualization feature provides a temporal aspect to illustrate how the living lab literature has evolved over the past five years. Finally, the co-occurrence network organizes the literature into seven different clusters to which I apply Dekker et al.’s (2020) four core elements and the “co-” paradigm (Brandsen et al., 2018; Schwoerer et al., 2022). In my application of Dekker et al.’s methodology to the findings, I found that all four elements are represented in the literature. Furthermore, the co-occurrence network illustrates how multiple concepts from the “co-” paradigm– not just co-creation–are present in the literature. This suggests that the “co-” paradigm may play a more significant role in the conceptualization of living labs than acknowledged.

The density visualization feature is the broadest scope of the bibliometric network, only taking into consideration the frequency of all terms. The frequency in which terms occur throughout the literature is important, signaling dominant features and focuses of living labs. The highest occurring terms are ‘governance’, ‘urban living lab’, and ‘design methodology approach’ It is important to note that urban living labs are commonly abbreviated or represented by the acronym ULL. One flaw of VOSviewer is that it is unable to recognize or combine terms with corresponding acronyms. This results in multiple nodes to describe the same concept. Therefore, it is difficult to assess the exact density of urban living labs as a whole but urban living labs may hold more significance than what is visualized in Figure 1. Regardless, it follows that urban living labs and governance are the most frequently occurring terms due to the proliferation of urban living labs and smart cities over the last decade. Urban living labs are considered

widely to be an experimental form of governance that strays from the traditional paths of policy legitimization and social organization (Wachter, 2023; Kronsell & Muhktar-Landgren, 2018). As a fairly new and experimental research methodology, it is clear that researchers have a lot of questions about urban living labs. Urban living labs have been defined 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. (JPI Urban Europe, p.1)

Urban living labs appear to be concentrated in the E.U. and are closely associated with social and environmental issues such as climate change, sustainability, and city planning (Wachter, 2023). Right away, this suggests a specific niche for urban living labs. An example of this is the CLEVER Cities project which employed nine urban living labs across the E.U. to implement Nature-based Solutions such as stormwater management activities and schoolyard projects (Bradley et al., 2022). Bulkeley et al. (2016) highlight that urban living labs are well suited to do this type of work because "[they] are seen as a means through which to gain experience, demonstrate, and test ideas, and co-develop new skills and actionable knowledge that is explicitly captured and used to inform the process of creating urban sustainability." (p. 14) The unique knowledge and outputs created from urban living labs connect to the frequency of "governance" in the literature as well. There is significant interest in how urban living labs intersect and diverge with

formal policymaking structures. Upon analyzing 50 different urban living labs across Europe, Kronsell & Muhktar-Landgren (2018) found that a majority of municipalities were engaged with living labs and often added legitimacy as a formal body of government. The emphasis on urban living labs and governance in the bibliometric network provides meaningful insight into one of the most common applications of the living labs methodology.

The overlay visualization in Figure 4 illustrates how areas of focus in the living lab literature have evolved over the past five years. Beginning in 2017, the initial focus in the literature appeared to focus on the approach, setting, and involvement of users in the living lab approach. This is demonstrated by the terms 'home,' 'end user,' 'new way,' 'ICT,' 'service innovation,' 'elderly person,' 'participatory design,' and 'test.' This aligns with the literature that focused on the development of living labs and as well as their application in a home environment for dementia patients (Van Den Kieboom et al., 2019). Moving into 2018, there is an introduction to terms such as 'design methodology approach,' 'expert,' and 'municipality.' Nods to "co-" paradigm concepts began to emerge in 2019 such as 'co-production,' 'public sector,' 'multiple stakeholder,' and 'urban actor.' From 2020 to 2021 discussions and applications of living labs were focused on the terms 'governance,' 'urban living labs,' and 'education.' The emergence of these topics illustrates the discussion going beyond the conceptualization of living labs and towards new applications that aren't focused on information communication technologies or healthcare. Finally, the most recent topics discussed in the literature are focused largely on sustainability, ecological issues, and food systems work. The temporal distribution of topics in the literature is important in demonstrating just how new this methodology is

with new conceptualizations and applications emerging every year. This also speaks to how adaptable the living lab methodology is.

The Four Core Elements of Living Labs in the Co-Occurrence Network

In my application of Dekker et al.'s methodology to the co-occurrence network, I found that all four elements are represented in the literature. Dekker et al.'s systematic literature review (2020) identified four core elements of living labs: "(1) living labs utilize a research and development process of innovation; (2) living labs collaborate between multiple stakeholders; (3) living labs take place in a real-life setting, and (4) living labs involve users as co-creators." (p. 1210) Each one of these elements can be applied to my findings to show the accuracy behind this newly formulated definition of living labs. Furthermore, the broad trends in the literature elaborate on Dekker et al.'s (2020) methodology by illustrating the different ways each core element can manifest. I will first start by discussing the key terms identified in the co-occurrence network that signal living labs are a research and development process of innovation. A research and development process of innovation is described by Dekker et al. (2020) as an iterative process that doesn't lock researchers into one single method at the beginning, rather researchers are expected to be adaptable in their approach to address new challenges as they arise. Therefore, I looked for keywords that contain innovation or language that differentiates living labs from traditional research and development processes. The most obvious example of this first core element in the literature is illustrated in cluster 7 (Orange). The entire theme of cluster 7 points to processes of innovation with key terms such as 'access,' 'new way,' 'catalyst,' 'innovation network,' 'innovation approach,' and

‘collaborative approach.’ Each key term in this cluster nods to living labs diverging from traditional research and development approaches. This is clear with the terms ‘innovation network’ and ‘innovation approach’ but the terms ‘access’ and ‘collaborative approach’ also contribute to the topic of innovation. The topic of access or accessibility is gaining attention in many different disciplines. Researchers are looking at social change through the lens of accessibility: who has access to decision-making processes and knowledge? Traditional research and development approaches are often closed off and controlled, therefore making information and outputs inaccessible to the general public. Looking back at figure 13, the term ‘access’ is the highest occurring term in cluster 7 and is connected to one or more terms from every single cluster in the network. This demonstrates the importance of access across all the living lab literature as well as how the topic of access can play a significant role in innovation.

Part of what makes living labs so appealing is the fact that innovation is an inherent part of the organizational structure and approach. By having innovation as a pillar of the living lab approach, any lab that applies it can create contemporary solutions that are tailored to their specific needs. Therefore, many different fields have cited innovative practices using the living lab approach such as healthcare (Hesseldal & Kayser, 2016), energy (Campos & Marín-González, 2023) information and communication technology (ICT) (Følstad, 2008), and even space exploration (Vidmar 2019). Furthermore, each living lab can hone in on the specific type of innovation that aligns with their research interests and needs. Specific types of innovation include technological innovation (n=15), innovation management (n=11), public sector innovation (n=5), open innovation approach (n=8), sustainable innovation (n=8), and

collaborative innovation (n=5). The highest occurring term, technological innovation, is represented in multiple clusters and fields of research. Findings like this are why I chose to analyze living labs using the method of bibliometric analysis. Not only am I able to confirm Dekker et al.'s finding that living labs utilize a research and development process of innovation; but I am also able to identify specific types of innovation processes being applied in living labs.

Next, I will apply Dekker et al.'s (2020) second core element of living labs to my VOSviewer findings. The second core element of the living lab methodology is a collaboration between multiple stakeholders such as universities, businesses, government organizations, or non-governmental organizations (NGOs) (Dekker, et al. 2020). There isn't one way to define collaboration or the extent to which stakeholders are expected to collaborate. Stakeholders can collaborate in a variety of ways- which will be covered more under the "co-" paradigm. For now, I will focus on the multiple stakeholders that are identified in the co-occurrence network. A variety of stakeholders can be identified in cluster 1 (red), cluster 2 (green), and cluster 6 (aqua). Cluster 1 identifies stakeholders in the field of healthcare, with many hospitals and care institutions for the elderly collaborating with researchers, doctors, nurses, and patients to provide better care (Van Den Kieboom et al., 2019). Next, cluster 2 suggests that higher education institutions (hei) are important stakeholders. Higher education institutions can connect researchers and students for collaborative learning experiences on campus, illustrated by the first application of a living lab as a course at Drexel University (Bajgier et al., 1991). Finally, cluster 6 (aqua) provides the most insight into living labs collaborating between stakeholders in the public, private, and government arenas. Cluster 6 includes the

following key terms: ‘multiple stakeholder,’ ‘expert,’ ‘enterprise,’ ‘municipality,’ ‘public sector,’ ‘public administration,’ and ‘co-production.’ The key terms in cluster 6 describe more types of stakeholders but it also provides a very significant clue to collaboration between them with the term co-production. The term co-production falls under the “co-” paradigm and signals a very specific type of collaboration between stakeholders that is taking place. Co-production can be considered as the final step in the “co-” paradigm following co-creation and co-design resulting in the production of a service, policy, or object for citizens (Brandsen et al., 2018). The co-occurrence between co-production and the specific stakeholders in cluster 6 may provide insight into the stage at which municipalities, public sector administrations, and enterprises are brought in to collaborate. Furthermore, co-production may indicate where the final service or policy is housed and implemented.

As a method of innovation, it follows that living labs do not take place in a traditional research and development lab. According to Dekker et al.’s (2020) third core element, living labs take place in a real-life setting. There is ample evidence in the VOSviewer co-occurrence network to support the finding that living labs take place in a real-life setting. As previously discussed, clusters 1 and 2 illustrate perfect examples of real-life settings related to healthcare and education. The highest occurring term in cluster 1 was “Home”, due to the application of providing home-based healthcare solutions for dementia patients. Real-life setting is also illustrated in cluster 2 with many living labs being housed in universities. However, cluster 4 (yellow) makes the strongest argument for living labs taking place in a real-life setting with the term ‘urban living lab.’ Urban living labs are one of the most prominent applications of the living lab methodology

(Bulkeley et al., 2016; Chroneer et al., 2019). Of course, living labs can take place in many different contexts.

The final core element of living labs is that they engage users as co-creators (Dekker et al., 2020). The idea of users as co-creators falls under the "co-" paradigm, yet it was the only "co-" singled out in Dekker et al.'s (2020) methodology. Therefore, I will apply the concept of users as co-creators the the VOSviewer network first, and then discuss it in the larger context of the "co-" paradigm. Dekker et al. (2020) found that living labs engage users as co-creators during early stages of the innovation process to incorporate user-perspectives and knowledge in the creation of a service or product. The concept of co-creation is applied in the network, but not as much as I would have expected. Co-creation is explicitly expressed in the co-occurence network through the terms 'cocreation' (n=6), 'co creator' (n=9), 'co creation process' (n=7). The first two terms are located in cluster 1, while co-creation process is found in cluster 4. The clusters in which specific mentions of co-creation are housed provides important insight into what type of living labs are applying co-creation methods. Cluster 1 has applications in the healthcare field, home-based care solutions for the elderly, and product development. There is also references to participatory design, provider, developer, consumer, end-user, and user-involvement. Meanwhile, cluster 4 is centered around urban living labs. This points to two main applications of living labs that actively pursue co-creation with users: healthcare living labs and urban living labs. The engagement of users at the beginning of the innovation process is particularly important for these two applications, as patients and citizens will be the primary users of the services and products created through the living labs. The timeline of user involvement in co-creation is key to this discussion. Perhaps, it

is why we do not see co-creation in other applications such as public sector innovation or higher education institutions. They may be engaged later on through co-production. I expected to see the element of users as co-creators represented more clearly in the VOSviewer network but perhaps the lack of it reveals more about the role of user engagement in living labs.

The Hidden Role of the "Co-" Paradigm

The VOSviewer co-occurrence network visualizes how living labs are conceptualized and applied in the broad literature. The key terms and elements I identified in the co-occurrence network support the four core elements in Dekker et al.'s (2020) living lab methodology. However, my findings also demonstrate that living labs engage in more than co-creation. I argue that the "co-" paradigm plays a hidden role in the living lab literature. In this section I will illustrate how the "co-" paradigm is woven throughout the living lab literature.

Although Dekker et al. (2020) describes the concept of co-creation as a core element, it plays a minimal role in the overall co-occurrence network. However, the overlay visualization map and co-occurrence network reveal two important aspects about the role of co-creation in living labs. First, the co-occurrence network identified co-creation key words in cluster 1 and 4 which reflect applications in the healthcare field and urban living labs. The overlay visualization feature shows that co-creation emerged early on with the first wave of literature in cluster 1. This suggests that co-creation was an element which was embraced in the early applications of living labs, and perhaps evolved, is implied, or faded with later applications.

The second concept under the "co-" paradigm is co-design. Similar to co-creation,

co-design engages user perspective but is implemented in later stages. Co-designed outputs can include: “a policy instrument, program, plan, service, or a new and innovative approach to management, service delivery or theory,” (Schwoerer et al. 2022, p. 5). With the possibility of co-creation and co-design processes overlapping, it is interesting that the term co-design is entirely absent from my bibliometric analysis results. However, while co-design is not named explicitly, there are key terms such as design process, participatory design, and service design all within cluster 1 where co-creation terms reside. The term participatory design being in the same cluster as co-creation suggests that there are co-design methods at play, even if they are not being named as such.

Finally, the third concept under the “co-” paradigm is co-production. Co-production is considered the last stage in the “co-” paradigm, resulting in collaboration or use in the final services or products rendered from co-creation and co-design processes (Brandsen et al., 2018). Interestingly enough, co-production (n=17) surpasses co-creation (n=6) in terms of frequency in the living lab literature. Co-production is largely associated with public administration and public sector innovation, linking the public with policy implementation processes. The volume at which co-production is mentioned is surprising, but it drives home the point that there is more to living labs than co-creation. Identifying the other concepts in the “co-” paradigm and their place in the living lab literature enhances our understanding of how users are included contribute to the collaborative aspect of the living lab methodology.

Conclusions

As a research methodology, the living lab is still in the early stages of development. Despite this, living labs holds great potential to address a wide range of contemporary issues. The VOSviewer bibliometric analysis networks demonstrate how much living labs have evolved in just over a decade with new applications and disciplines emerging frequently. The co-occurrence network highlights prominent applications of living labs focusing on urban living labs, sustainability, education, healthcare, ICT, and more. The overlay visualization features highlight how new applications have emerged over time, with a recent focus on sustainability, urban living labs, and environmental issues. Some research methods are better suited for specific fields, but living labs demonstrate the range of this fluid research methodology.

The diversity in living lab applications can make it difficult to discern the limitations and value of this emerging research methodology. The findings from my research help reduce conceptual ambiguity by confirming Dekker et al.'s (2020) four core elements of living labs in the broader literature. The identification of these four core elements help to set living labs apart from other emerging forms of public sector innovation. It is essential to be able to distinguish living labs from other research methodologies as researchers seek to replicate the living lab methodology across the globe. Furthermore, my research builds upon Dekker et al.'s (2020) four core elements by suggesting that living labs engage in much more than co-creation. The "co-" paradigm is deserving of more attention in the conceptualization of living labs. Revealing the hidden role of "co-" paradigm concepts can contribute to a more accurate conceptualization of living labs and their capabilities to engage users throughout the innovation process.

Living labs have suffered from vague language and co-opted uses. The addition of the "co-" paradigm combats this by clarifying how and when living labs engage with users to create products or services meaningful to them.

My results support the literature positioning the living lab as a unique research methodology distinct from other public sector innovations and policy labs. However, for living labs to evolve beyond a buzzword there needs to be more efforts to determine the boundaries of its applications and methods. Not everything is a living lab, and co-opted uses of the word risk the living labs validity as a research methodology. The inclusion of the "co-" paradigm equips researchers and practitioners with language to describe the important collaborative aspect of living labs with accuracy.

Appendix A

Table A

VOSviewer Network Keyword Strategy Terms Removed

VOSviewer Network Keyword Strategy	
Terms Removed (n=55)	
• Attempt • Beginning • Bottom • Call • Day • Decade • Fact • First part • First time • Hand • High level • Increase • Last decade • Latter • Lens • Leverage • Limit • Line • Link • List • Lot • Main contribution • Main finding • Meaning • Means • Month • Narrative	• One • Overview • Paper analyze • Past • Past decade • Practical implication • Present • Pressure • Publication • Range • Reducation • Regard • Relevance • Research limitations implication • Research result • Rise • Search • Second part • Semi • Sensor • Series • Start • Systemic literature review • Systemic review • Thing • Top • Total • Trade-off

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Analyzing a Local Application of the Living Lab Methodology: A Case Study of the Lake Superior Living Labs Network

Introduction

The introduction and advancement of living labs over the last two decades position it as a unique research methodology worthy of more attention. The living lab literature identifies a wealth of applications in a variety of disciplines. My research contributes to the ongoing conceptualization of living labs by identifying key characteristics and prominent applications of this novel methodology. My research demonstrates how Dekker et al.'s (2020) four core elements of living labs and the "co-" paradigm are applied in a regional living lab network situated in the Lake Superior watershed.

The opportunity to study a specific living lab in my local community provides invaluable insight into a real-life application of this emerging research methodology. The Lake Superior Living Labs Network (LSLLN) is a regional network composed of four living lab hubs located in Thunder Bay, Ontario; Sault Ste. Marie, Ontario; Houghton, Michigan; and Duluth Minnesota. The LSLLN was launched in 2018 to connect researchers and community organizations with a vested interest in the Lake Superior watershed.

The LSLLN is a particularly unique application of the living lab methodology and worth studying for several reasons. First and foremost, the proximity of the LSLLN made it an appealing candidate for a case study, especially with the timing of the addition of the Houghton hub coinciding with the start of my study. The Houghton hub is housed

through Michigan Technological University which provided valuable insight for me as a Michigan Tech student and as a researcher trying to understand how living labs are applied and develop in real time. At the beginning of my case study I was an undergraduate student pursuing a degree in Sustainability, Science, and Society at Michigan Technological University with hopes to find a career studying food systems after graduation. Naturally, I was drawn to study the LSLLN for its focus on sustainability and food systems intiatives.

The location and scale are also important characteristics that make the LSLLN stand out. With a few exceptions, living labs are typically singular phenomenon operating in one specific area. The network composed of four different hubs connected at the watershed scale is unusual but then again, this isn't just any watershed. The Lake Superior watershed provides a rare political, cultural, and ecological space to implement a living lab. Lake Superior is vast bordering the shores of Michigan's Upper Peninsula, Wisconsin, Minnesota, and the Canadian Province of Ontario. Providing more than 20% of the world's fresh drinking water, Lake Superior is arguably one of the most important natural resources in the world (Langston, p.1). The Superior watershed is home to multiple indigenous tribes and part of the traditional land of the Anishinabek people in the United States and Canada. The management and conservation of the Lake Superior watershed requires cultural and ecological knowledge as well as many different layers of political cooperation. Therefore, a case study on the LSLLN has the potential to demonstrate how living labs impact international and domestic environmental policy and conservation efforts through civil engagement and collaborative governance.

With the LSLLN identified as my focus, I chose to do a case study to incorporate mixed qualitative methods for rich data collection including semi-structured interviews with network leads and content analysis using Grounded Theory methods (Charmaz, 1996). The LSLLN was newly established, with only two years under its belt at the start of my research. By implementing a case study, I was able to gain more insight into the structure and goals of the network than if I had just completed a content analysis. It is also important to note that my research took place during the COVID-19 pandemic. Therefore, it was critical for me to have a multi-faceted research approach to address network setbacks and personal barriers to travel and in-person observations. The results of my case study illustrate how the LSLLN aligns and diverges with the broader conceptualization and application of living labs. I apply Dekker et al.'s (2020) four core elements of living labs to my findings to illustrate how the LSLLN aligns with the broader conceptualization of the living lab methodology. Additionally, the results my case study on the LSLLN inform our understanding of living labs ability to engage users at different stages through "co-" paradigm concepts. My findings validate Dekker's methodology in an applied context and uncovers the hidden role that the "co-" paradigm plays in the living lab approach.

Methodology

The ambigious conceptualization of living labs and unique context of the LSLLN make it well suited to be the focus of a case study. I applied a case study research strategy for its ability to "investigate a contemporary phenomenon with its real-life context, especially when the boundaries between the phenomenon and context are not clearly evident." (Yin, p. 13) I employed a combination of qualitative social science research methods in my

case study of the LSLLN such as semi-structured interviews and content analysis of various texts using grounded theory methods (Charmaz, 1996). My research took place over roughly two years under the guidance of my advisors Dr. Carter and Dr. Wellstead. My case study was launched in 2021 under Michigan Technological University's Undergraduate Program for Exploration and Research in the Social Sciences (UPERSS) and continued into the fall of 2023 as part of an ongoing research project analyzing Policy Innovation Labs through the US-Israel Binational Science Foundation.

Beginning in 2021, I conducted interviews with two Lake Superior Living Labs Network members as well as a content analysis of the network's annual reports, publications, and website. The interviews and content analysis of publications and materials resulted in primary and secondary data to be analyzed. I analyzed all sets of data using grounded theory methods (Charmaz, 1996), meeting frequently with my research advisor to discuss emergent codes and categories. Charmaz (1996) describes grounded theory methods as a "logically consistent set of data collection and analytic procedures aimed at developing theory" (p. 27). An important analytic component of grounded theory is coding data to identify and develop key concepts as they are presented in the data. This is a stark contrast to quantitative forms of coding which utilize predetermined categories and codes created before data collection for analysis, which phrases and keywords either fit into or don't (Charmaz, 1996). This generative method provides important insight as the living lab methodology is still an emerging concept. Grounded theory is an iterative process that creates theories and concepts directly from the data, line by line. Charmaz (1996) highlights the benefits of grounded theory methods: "They provide rigorous procedures for researchers to check, refine, and develop

their ideas and intuitions about the data. In addition, these methods enable the researcher to make conceptual sense of large amounts of data" (p. 28). Finally, grounded theory methods are an appropriate method for this case study because they are used to test concepts and relationships among concepts (Strauss and Corbin, 1990, as cited in Hull, 2013). In this case, I apply grounded theory to look at the relationship between the broader conceptualization of the living lab methodology and an actual application of the living lab methodology in a local context. Through grounded theory methods, I am able to examine the relationship between key concepts from the literature such as Dekker et al.'s (2020) four core elements and the "co-" paradigm and their applicability to the LSLLN.

Grounded theory methods have six distinguishing characteristics, which I used to guide my analysis of the Lake Superior Living Labs Network. Here I will briefly describe each characteristic as well as how each one was implemented as a part of my research methods. Grounded theory methods (see Charmaz, 1983, 1990, 1996; Glaser, 1978, 1992; Glaser and Strauss, 1967; Strauss, 1987; Strauss and Corbin, 1993) have the following six characteristics:

> (1) Simultaneous involvement in data collection and analysis phases of research; (2) creation of analytic codes and categories developed from data, not from preconceived hypotheses; (3) the development of middle-range theories to explain behaviour and processes; (4) memo-making, that is, writing analytic notes to explicate and fill out categories, the crucial intermediate step between coding data and writing first drafts of papers; (5) theoretical sampling, that is, sampling for theory construction, not for representativeness of a given population, to check and

> refine the analyst's emerging conceptual categories; and (6) delay of the literature review. (p. 28).

I implemented each one of these characteristics in my analysis of the primary and secondary data on the Lake Superior Living Labs Network. First, I had simultaneous involvement with data collection and analysis by allowing the emerging concepts and questions to guide my next steps in the analysis. For example, my interview questions started broadly looking at the structure, initiatives, and outputs of the LSLLN. However, as my analysis developed it was important for me to understand how the LSLLN engages in community change in non-traditional research and development processes and the theories that inform their work. My analysis experienced multiple iterations, including new data from recent events and updated reports published on the LSLLN website.

Second, I created analytic codes and categories developed directly from the data by coding each interview transcription and publication line by line. I was careful to identify or use key terms verbatim. Each line was color-coded and tagged for important concepts in the reference management software Zotero. Furthermore, the analytic codes and categories I created were not derived from pre-conceived notions or concepts taken from the VOSviewer analysis because that research project had not yet begun. The interview, transcription, content analysis, and coding processes are outlined further in the designated sections. Next, I was able to develop middle-range theories to describe behaviors and processes by understanding the local geographic, political, and social context potentially influencing my case study. For example, my case study began at the start of the COVID-19 pandemic. This called for consideration of the impacts the pandemic had on LSLLN's collaborative efforts, outputs, and events during this time.

Memo-making was critical in my analysis of the primary and secondary data I collected. Each interview transcription or document that was coded line by line has one or more corresponding memos. This allowed me to develop and refine the categories that emerged in each source of data. Most importantly, the memos helped me to quickly connect emergent concepts across all of my collected coded data. I followed memo-making with the next step identified by Charmaz (1996) which is theoretical sampling. In this step, I was able to sample other theoretical frameworks attempting to conceptualize living labs and their applications, such as Dekker et al. (2020). Sampling Dekker's framework provided broad context to the emerging categories and characteristics of the Lake Superior Living Labs Network.

The final grounded theory characteristic implemented in my analysis was to delay my literature review until the previous steps were completed. Throughout this iterative processes of collecting and coding data and theory development, I met regularly with my research advisor to share, discuss, and refine my data collection, coding, and theory development. codes, memos, and theories. Once my analysis of the key characteristics of the Lake Superior Living Labs Network was completed, I was able to complete a thorough literature review to see how this analysis aligns with the broader conceptualization and applications of living labs.

Interview Methods

In 2021, I conducted two semi-structured interviews with Lake Superior Living Labs Network leads. I made the decision to employ interviews as part of my case study methodology for the rich qualitative data that would result from insider knowledge. Interviewing network leads allowed me to ask specific questions not found on their

website or in the literature. Furthermore, the interview process was able to capture characteristics and anecdotes about the individuals driving the work. This was especially important to understand the intentions behind the creation of the LSLLN and initiatives that were on hold due to the pandemic. I conducted semi-structured interviews guided by Jacob and Furgerson's (2012) interview protocols. The interviews were semi-structured guided by a script and a set of questions developed with the guidance of my advisor Dr. Carter. The semi-structured format utilized open ended questions and gave space for me to deviate from the script to discuss topics as they naturally emerge in conversation. Due to the COVID-19 pandemic, both interviews were conducted virtually over Zoom. Under the supervision of Dr. Carter, my research advisor, an IRB application was submitted to gain human subjects' approval (See Appendix B). My proposed research posed low risks and was determined exempt in March 2021.

Once I had IRB approval, I began outreach to lead members of LSLLN. Two members of the LSLLN steering committee, including the network lead, agreed to be interviewed. I reached out to all hub leads over email but received limited responses. I was awarded a travel stipend which would have greatly enhanced my opportunities to engage with the LSLLN and visit the different hubs but unfortunately in-person outreach was not an option due to the pandemic. Regardless, the members that I did interview provided valuable feedback about the structure, goals, and activities of the LSLLN, especially with the newly formed Houghton hub which had no information to publish yet. The content analysis provides some compensation for the remaining hubs unavailable for interviews by highlighting specific initiatives and activities. However, I acknowledge that

my case study is limited by not being able to conduct interviews with all of the LSLLN hub leads.

At the beginning of the interviews, I obtained oral consent (See Appendix B) from participants and provided a brief overview of how these interviews would inform my research on living labs. With consent, interview audio was then digitally recorded and transcribed. I used an interview guide to direct the interviews as a dialogue, as outlined by Jacob and Fergerson (2012); the interview guide included broad, open-ended questions about the LSLLN, food sovereignty, place-based research, and community collaboration as outlined in Appendix B. After I transcribed the interviews using OtterAI, I reviewed the audio and transcription for accuracy before coding. I then coded the transcript into categories line by line using grounded theory methods (Charmaz 1996). I created coded categories by identifying reoccurring keywords and topics of interest. Additionally, I created categories carefully based on the context in which keywords or phrases were used. I was careful to extract words verbatim in my memos and coding. For example, if the conversation was about lake pollution in general then it was coded under "environment," however, specific mentions of Lake Superior by name or context are coded under "place" because it is specific and references a geographic location. As each interview was coded, I created memos to highlight commonly occurring topics or phrases that could be connected between interviews and the broader content analysis.

Content Analysis Methods

Limited by the COVID-19 pandemic, I chose to do a qualitative content analysis to complement the findings of my interviews and fill in any remaining gaps. Qualitative content analysis methods allow for identification and interpretation of underlying themes

(Kohlbacher, 2006). The fragmentation in the conceptualization of living labs thus far means that it is essential to be able to interpret the vague and overlapping language used to describe living labs for a better picture. The content analysis consisted of three annual reports, terms of reference, and website content available on each hub's initiatives. I analyzed these sources of data by applying the same grounded theory methods (Charmaz 1996) used for the interviews. I selected content based on the availability and direct connection to the Lake Superior Living Labs Network. Therefore, any items published by the network such as annual reports and key terms were eligible for analysis. On the other hand, authorship alone was not enough to be considered for eligibility. Publications by LSLLN members were only considered if they directly related to the initiatives and activities of an LSLLN hub or the network as a whole. Given these requirements, I included annual reports, publications, and landing pages from the LSLLN's website in the final content analysis.

Results

Interview Results

The first interview was conducted virtually over Zoom with the LSLLN network lead, located in Thunder Bay, Ontario. The interview was transcribed and analyzed using line-by-line coding and memo-making processes. The analysis of the first interview resulted in the identification of the following nine topics (1) Food: mentions of food, food sovereignty, and food access, (2) environment: mentions of environmental issues such as pollution, climate change, or the natural world, (3) social interactions or connections (4) people: specific mentions of individuals or organizations, (5) Places: the mention of place physically, geographically, or how we are situated within the physical or social

environment, (6) Social justice: the mention of social justice issues such as racism or sexism, (7) Sustainability: the mention of the term sustainability or the idea of providing for future generations, (8) Education: including academia, universities, teaching, learning, and different ways of knowing or knowledge production, and (9) Governance: the mention of governing forces, structures, institutions, policies, and regulations.

Interview one provided valuable insight into the history of the LSLLN and its goals and objectives. The first interview served as a primer for understanding the LSLLN's structure, with context for the decision to address issues at the watershed scale:

> *How do we understand each other more if we're going to solve some of the big issues like racism [and] climate change? We can't do that in a bubble, we need to be connecting with others and at this stage it makes the most sense not to necessarily think of our work in political borders or universities or municipal borders but thinking about it as a region. And to do that, we talk about ecosystems, we talk about watersheds–the Lake Superior watershed is the region.*

This conversation revealed that the unique network structure of the LSLLN was an intentional decision made at the very start. Furthermore, it provides context for understanding how place–at the watershed scale– impacts the various issues the LSLLN is trying to address. Interview one detailed how issues of food sovereignty and food security are directly related to the location and features of the Lake Superior watershed:

> *It is not easy to move food around this region because so far apart and there's not a lot of money to be made by doing that. So, Thunder Bay gets like we have three Walmart's and tons of grocery stores. We're a big city, but you go North o some of the northern communities there's sometimes no grocery stores or there's one*

grocery store in the northern flying communities. They have something called the northern store, which is like one company that basically controls everything so. That is, to me, the opposite of food sovereignty, like when you have food systems that are completely under corporate control. And it's not just about the food it's about you have systems where you know, the ability to have a garden or go hunting or gathering is limited because of policies or regulations or rules that are made by government.

The first interview emphasized the importance of place and the thought processes driving the unique network structure. The findings from interview one gave a strong overview of the LSLLN's goals as a network.

The second interview was also conducted virtually over Zoom, with the lead of Lake Superior Living Labs Network's newly introduced hub in Houghton, Michigan. This interview was then transcribed and analyzed using the same methods as the first interview. From this interview, nine key topics were identified and sorted into the following categories: (1) Environment: environment: references to the environment, geology, climate change, and physical characteristics of the local environment, (2) Education: including academia, universities, teaching, learning, and different ways of knowing or knowledge production including indigenous knowledge, (3) Society or Community: Broader society, social connections, community, large groups of people. Utilizing descriptive words such as collaboration, partnerships, and community. (4) People: Specific mentions of people or organizations that could be considered as partners or stakeholders such as Keweenaw Bay Indian Community and Professors at Michigan Technological University. (5) Place: Mentions of place, specific or broadly, place-based

research or work. This can also overlap with the environment. Some examples include Keweenaw Bay, Copper Country, Isle Royale, Keweenaw, Houghton, and Gay. (6) History: topics relating to past events, ecologically or human-driven. Examples include mining legacies; the local history of copper, and geoheritage. (7) Sustainability: Mentions of sustainability, including sustainable tourism and sustainable economic opportunities. (8) Food: mentions of food in relation to the environment. (9) Challenges: Issues that need to be addressed by the network or issues being faced by the network. Challenges include COVID-19 as a barrier to outreach, environmental pollution, and climate-related events impacting fisheries and wild rice harvests.

Interview two provided insight into the start of a new hub and how individual hubs can be further tailored to the local history. The Houghton Hub lead acknowledges the importance of local history through the inequalities and damage that persist from the Keweenaw Peninsula's mining legacy:

> *[W]hen you've got the stamp sands that are now moving out into the lake, and they're interfering with places like the Buffalo Reef, which is a spawning ground for white fish and lake trout. So then you start to see sort of how this past is now actively impacting our present and what we need to look for in the future.*

This highlights how the environment and history are entangled as well as how each hub still faces challenges unique to their area. Improving the health of Buffalo Reef improves the overall health of Lake Superior, but local knowledge is acquired.

The two interviews reveal important information about the scope of issues and the scale at which they are addressed across the network. The first interview provided important findings for the overall structure and goals of the lab, along with some specific

examples of initiatives. Interview one emphasizes the importance of operating at a watershed scale, while interview two highlights why it is important for individual hubs to have autonomy over research projects in their specific area. The importance of place is reiterated throughout each interview and applied throughout the activities of the network.

Content Analysis Results

The categories outlined in Table 2 were established through underlying concepts and common topics of discussion in published content. Categories were developed through many iterations of coding. In this section, I will briefly detail how some of the key categories were developed from the concepts identified through coding.

The category of place, specifically the Lake Superior watershed, is the foundation from which the LSLLN's main objectives stem. The category of place emerged from language used to describe and characterize physical spaces and environments, the geographic and political boundaries that encapsulate them, and mentions of specific locations. This includes words that expand on the scope of place such as regional, local, and international, or characteristics of a place such as rural and urban. The category of place encompasses both the natural and built environment, from rhubarb patches in the Roots to Harvest Community Garden (CAFS Report 2023) to Solar Commons in Bois Forte, Minnesota. Descriptions of place can be incredibly specific or broad generalizations. The category of place significantly overlaps with the categories environment and community because one cannot exist without the other. Furthermore, place serves as the foundation in which all remaining categories identified are rooted in. In this way, the category of place can be seen as the overarching concept defining the LSLLN in everything that they do.

The category of sustainability emerged as one of the main objectives of the LSLLN. The term sustainability was mentioned explicitly in both interviews and all content analyzed. Sustainability is categorized through topics of climate change, sustainable tourism, renewable energy, freshwater stewardship, ecological justice, seed saving, and more. Furthermore, sustainability-related teaching, research, and action are outlined as one of the network's intended outcomes. Closely related to the category of sustainability is the category of environment. While the environment is deeply intertwined with sustainability studies, this also covers the broader characteristics, observations, and issues related to the natural world. The environment is discussed frequently, with explicit and implicit mentions. Explicit mentions include topics of environmental justice, environmental pollution, and the impacts of climate change on the local environment. Environment is also discussed in terms of features or characteristics specific to the region, such as the surrounding geology and hydrology of Lake Superior. Therefore, environmental studies emerge as another key objective of the LSLLN.

Many of the goals and initiatives of the LSLLN fall under the category of social justice. The category of social justice is formed through explicit mentions of social justice or references to broader social issues such as poverty, access to healthcare, food insecurity, and more. Social justice is also categorized through LSLLN's efforts to incorporate discussions about equity, power, and privilege into their initiatives.

Table 2.1. Summary of Content Analysis Categorization

Title of Content Analyzed	Overview	Key Terms and Concepts Identified	Categories Developed
Goals and Intended Outcomes	Webpage on LSLLN's website detailing two specific goals and how the network intends to achieve them through various actions.	Sustainability-related Lake Superior Watershed Teaching/Education Partners Research Collaboration	Place Environment Education Community Stakeholders Sustainability Approach Social justice
LSLLN Annual Report (2019-2020)	A report detailing the LSLLN's purpose, goals, individual hub activities, and survey results from 2019 to 2020.	Lake Superior, Watershed, University, Teaching, Knowledge, Climate Change, Campus, Sustainability, Pollution,	Place Education Environment Sustainability
LSLLN Year 2 Survey Report (Nov 10, 2021)	Survey results highlight LSLLN participants' contributions to the network and how LSLLN has contributed to such work.	Relationships, Partnerships, Capacity, Research, Watershed	Collaboration Stakeholders Place
LSLLN 2023 Summary Report	A report that gives an overview of the hubs, summarizing goals, initiatives, outputs, events, and survey results from year 3.	Sustainability, Watershed, Lake Superior, Collaboration, Participants, River, Water, Climate change, Climate Justice, Anishinaabe	Place Environment Sustainability Community Approach History Stakeholders Education

Title of Content Analyzed	Overview	Key Terms and Concepts Identified	Categories Developed
		people, Research, Experimental Research, Indigenous Knowledge, Education, Academia, etc.	
LSLLN Working Terms of Reference (2022)	Provides background information on the LSLLN, highlights governance and organizational structure within the network, and defines member roles.	Lake Superior Watershed, members, participate, contribute, collaborate, engage, capacity, approach, academic, partnership, network, lead, hub, community, communication, committee, etc.	Collaboration Stakeholders Governance Place
A Scoping Review Examining Governance, Co-Creation, and Social and Ecological Justice in Living Labs Literature (2022)	A literature review conducted by LSLLN members to understand how university-based living labs address issues of sustainability and social justice.	Co-creation, research, knowledge, real-life, university, concept, governance, setting, place, learning, urban, stakeholders, approach, sustainability, social justice, environment, practice, etc.	Governance Sustainability Collaboration Social Justice Environment Place Approach(es)
LSLLN Climate Action Field School Report (2023)	A report summarizing the activities of the LSLLN-led Climate Action Field School.	Climate Change, Sustainability, Education, Teaching, Knowledge, Collaboration, Students, Community, etc.	Environment Sustainability Place Education Collaboration Stakeholders

Discussion

The findings from my case study of the Lake Superior Living Labs Network provide significant insight into a real-life application of the living lab methodology. The results of the coded interviews and content analysis contribute to three main findings. First, my findings demonstrate how the LSLLN aligns with the broad literature working to conceptualize the living lab methodology. In the first section of this discussion, I apply Dekker et al.'s (2020) four core elements of living labs to the categories developed from the interviews and content analysis. The categories I identified in my case study demonstrate how the LSLLN fulfills all four core elements outlined by Dekker et al. (2020). In the second section, I discuss how my findings apply to the "co-" paradigm. I address how the LSLLN engages in co-creation and potential representations of co-production. In the final section, I discuss how the LSLLN is unique in its nested network structure and application by focusing on research areas such as food sovereignty and social justice. The ways in which the LSLLN diverges from the broad conceptualization and applications of living labs hold significant implications for future research as this novel research method continues to evolve.

The Four Core Elements Applied.

My analysis of the Lake Superior Living Labs Network provides important insight into a somewhat unusual application of the living lab methodology in my local community and the greater region. As I work to clarify the conceptualization of living labs my findings on the LSLLN demonstrate how one of the leading definitions of living labs put forth by Dekker et al. (2020) is applied in a real-life living lab. The LSLLN engages in each of the following core elements of living labs to some degree:

"(1) living labs utilize a research and development process of innovation; (2) living labs collaborate between multiple stakeholders; (3) living labs take place in a real-life setting, and (4) living labs involve users as co-creators." (Dekker et al., p. 1210)

The representation of each core element in the LSLLN's objectives and activities is vital to understanding how living labs function and align with the broader literature.

The first core element of living labs is that they use iterative research and design methods to produce innovative outcomes or products (Dekker et al, 2020). The LSLLN engages in innovative research and development by uniting multidisciplinary approaches to inform their work in a variety of creative ways. The category of multidisciplinary approaches emerged from references to various research approaches, frameworks, methods, or models employed or integrated into the LSLLN. This includes explicit mentions of place-based learning and research, experiential learning, exploratory design, and problem-solving approaches. The LSLLN is not tied to one specific approach or method, incorporating different approaches best suited for their many initiatives across the watershed. For example, the LSLLN's Climate Action Field School was developed using an "experiential, problem-based pedagogical approach and a head-heart-hands model for transformational learning" (Portinga et al., p. 10). This was applied for this specific initiative, but if the network finds that this didn't provide the results or engagement they had hoped for they can easily pivot their approach for the next Climate Action Field School. The category of multi-disciplinary approaches can also be complemented by the category of education. Each hub is housed in a regional university, providing many opportunities for researchers and students from various disciplines to connect their knowledge. This is exemplified by the 2022 Climate Action Field School

reception of Lakehead University's Teaching Innovation Award (Portinga et al, 2023). The category of multidisciplinary approach(es) applied by the LSLLN demonstrates that innovation is an iterative process, accelerated by having the flexibility to adapt or change your approach as new challenges arise.

The second core element of living labs involves collaboration between multiple stakeholders (Dekker et al, 2020) which is well represented and applied by the LSLLN. The categories stakeholders, governance, and collaboration summarize how the LSLLN engages in this core element of the LL methodology. First, the category of stakeholders represents mentions or references to the various partners that collaborate with the network. Stakeholders include individual partners, researchers, students, local organizations, municipal governments, university faculty members, students, and more. Specific stakeholders mentioned are listed in the Terms of Reference (2023) on the LSLLN's website. The categorization of stakeholders has the potential to overlap with the concept of community, but it is distinctly different in that stakeholders can make decisions or have a vested interest in the activities implemented by the LSLLN. Identifying stakeholders across the watershed is a critical aspect of the LSLLN's work as they search to address common issues at the watershed scale. The stakeholders provide critical insight into the work already underway in communities and the LSLLN provides a platform to discuss and develop these ideas further. The LSLLN connects members through mini-meetups and webinars (Portinga et al. 2023), utilizing technology to overcome barriers such as the COVID-19 pandemic and distance.

Governance is another category that contributes to our understanding of how stakeholders engage in collaboration. Living labs are implemented and housed in many

different types of organizations and disciplines, meaning there is no clear-cut guide for the broader governing structure of this novel approach. The topic of governance and decision-making structures in the LSLLN came up in interviews as well as in the content analysis. The LSLLN has made an effort to be transparent with its governance structure, highlighting members' roles and responsibilities in their Working Terms of Reference (2023) document available publicly through their website. This helps shape the general expectations for how members are to collaborate and produce change within the network. The LSLLN is shaped by a steering committee that is responsible for the management and maintenance of network tasks such as outreach, research, applying for funding, and support of hub members (Portinga et al, 2023). The next tier of decision-makers is called the collaborator membership in which members are expected to actively participate in Network meetings, initiatives, and research. The final tier of the LSLLN governance is titled Friends Membership, which is less invested in the entire network and instead highlights participation within their local hub. Through multi-level governance, the LSLLN encourages members to collaborate on various levels and projects. LSLLN's year two survey results highlighted community networking and cross-sector collaboration as key benefits of participating in the network (2021). The importance of networking at the watershed scale was identified quickly in my first interview and remains an integral part of the LSLLN.

Collaboration between stakeholders is also well represented by cross-hub collaboration activities. One of the main objectives of the LSLLN is to address issues of sustainability in the Lake Superior watershed. Again, the Climate Action Field School put on by the LSLLN demonstrates how different hubs and stakeholders collaborate to realize

their objectives. The 2023 CAFS collaborated with a variety of community partners such as the Lakehead District School Board, Lakehead University, EarthCare in Thunder Bay, and more (Armiento and Galway, 2023). As the pandemic subsides and the LSLLN continues to grow, I expect to see more opportunities for collaboration among stakeholders in the near future.

The LSLLN demonstrates the third core element of Dekker et al.'s (2020) methodology by taking place and focusing on a real-life setting in the Lake Superior watershed. It is critical to reiterate how each category summarizing the objectives and initiatives of the LSLLN is rooted in a real-life setting. Each hub is affiliated with a local university, but the research focus and activities happen in multiple real-life settings throughout the watershed. Sustainability is discussed in the context of the local environment. Sustainability initiatives taking place in a real-life setting can also occur on different scales. Sustainability initiatives can take place on campus through teachings or at a much larger scale through regional projects. The topic of eco-tourism and sustainable economic opportunities was discussed in my interview with the Houghton hub lead. This is also true for the environmental objectives being taken on by the LSLLN, which are rooted in a multitude of real-life settings. The pressing environmental issues discussed and addressed by the LSLLN such as climate change, pollution, and coastal erosion, all take place in different but real-life settings. From classrooms to fisheries to farms, to community gardens. The real-life settings in which these activities and research projects take place are unique to the watershed, utilizing place-based learning and research. The four hubs are united by their real-life setting, sharing similar experiences and issues rooted in the isolated geography and northern climate of the Lake Superior watershed.

The final core element of living labs identified by Dekker et al. (2020) is that users are involved as co-creators. Co-creation is broadly described as the involvement or input from users during the early stages of the development of a product or service (Dekker et al. 2020) and falls under the co-paradigm with co-design and co-production (Schwoerer et al., 2022). In my content analysis, I identified multiple instances of the LSLLN using the term co-creation to describe their objectives or goals. The Climate Action Field School (CAFS) in 2023 provides a strong example of co-creation which engaged users (the students interested in participating in the field school) early on in the strategic planning of the event through a brainstorm workshop (Portinga et al., 2023). The brainstorming session served as a way for prospective participants to share what they wanted to learn, what challenges they faced, and who they wanted to learn from- shaping the activities implemented later on during the CAFS. This serves as a significant example of co-creation implemented by the LSLLN.

Another example of co-creation implemented by the LSLLN comes from the Sustainability Stories Video Series. The LSLLN describes the video project as being co-created with members of the Thunder Bay hub. The project features stories from different community members and hub members describing what sustainability looks like in practice in the Thunder Bay area. The first video in the series was co-created with Lakehead University's Elder-In-Residence Gene Nowegijick to share his perspective on sustainability. This offers a deeply important message about sustainability from a cultural perspective rooted in Anishinaabeg knowledge and teachings. The co-creation process for the sustainability series was not defined as clearly as instances of co-creation in the CAFS, but this provides important insight into the development of the LSLLN and its

practices. The co-created sustainability series took place in 2020, while the most recent descriptions of co-creation in the CAFS were reported in 2023. This suggests that the LSLLN may be making more of an effort to clarify how they engage users and community members.

Representation of the "Co-" Paradigm.

The broad conceptualization of living labs is continually evolving. The introduction of the "co-" paradigm has important implications for our understanding of the living lab methodology. My case study findings confirm how the LSLLN engages in co-creation, one of the concepts under the "co-" paradigm. While the concepts of co-design and co-production are not mentioned outright by the LSLLN, my findings indicate that there are potential ways that the LSLLN is engaging in co-production without explicitly acknowledging it. Co-production can be thought of as the service, policy, or object that has been produced as the result of co-creation and co-design (Brandsen et al., 2018). Co-production can also be understood as the value and knowledge that has been produced through the living lab methodology. The LSLLN engaged in co-creation for the sustainability series, but the long-standing resource and knowledge that was created from that project can also be considered the results of co-production. Furthermore, the knowledge that is produced from webinars and activities such as the Climate Action Field School can be considered co-productions of the LSLLN. The difference between co-creation and co-production relies on the implementation stage- with co-production landing in the later or final stages with continued use by users. The co-production of knowledge and future activities could be an avenue worth exploring for the LSLLN.

Unique Characteristics of the LSLLN.

While the LSLLN aligns with many of the concepts in the broad literature it is worth noting how it diverges from common applications of living labs. The first characteristic that sets the LSLLN apart from its peers is the network scale which it operates. In my review of the literature, I was not able to find another living lab that was structurally similar to the LSLLN. While there are smaller networks in Europe as well as the large European Network of Living Labs (ENOLL), nothing compares to the watershed scale that the LSLLN exists at. Beyond the watershed scale is the fact that the LSLLN spans a multitude of geographic and political borders, partnering with universities and community organizations in Canada and two U.S. states. The watershed scale of the LSLLN has important implications for future research and applications for living labs. Particularly in the regard to shared natural resource management. The network provides a platform for researchers to collaborate and fill knowledge gaps that may not be addressed through traditional policy arenas. Finally, the LSLLN's focus on food sovereignty and social justice is noteworthy. While these topics have been addressed in the literature, these topics are in the minority of living lab applications. The focus on food sovereignty, social justice, sustainability, and environmental issues demonstrate how the living lab methodology can be applied to a variety of interrelated issues at once. Furthermore, the focus on food sovereignty and social justice identify new and innovative ways outside of the traditional social science approaches used to address these issues.

Conclusion

The Lake Superior Living Labs Network (LSLLN) is a unique application of the living lab methodology, spanning four different locations at the watershed scale. My case

study examines how a real-life living lab in my local region aligns with the broader conceptualization and applications such as the four core elements of living labs (Dekker et al., 2020) and concepts from the "co-" paradigm (Brandsen et al., 2018; Schwoerer et al., 2022). The implications of my research inform how relevant the broad literature is in my local region. The LSLLN utilizes multi-disciplinary approaches with an emphasis on place-based learning and engages frequently in collaboration with stakeholders to meet their objectives. The findings inform how the four core elements of living labs (Dekker et al., 2020) are represented in a local application of the living lab methodology with the LSLLN engaging in each core element to varying degrees. Finally, the results shed light on the role of the "co-" paradigm. The LSLLN has explicit examples of co-creation and outputs that can be interpreted as the result of co-production.

Not only does my case study align many of the findings in the living lab literature but it also highlights how the living lab methodology can be utilized to address important issues faced by communities surrounding the Lake Superior watershed.

Appendix B

IRB Exemption Request Application

Michigan Tech

Office of Compliance, Integrity, and Safety
Phone: 906-487-2902 E-mail: IRB@mtu.edu
1400 Townsend Drive
Lakeshore Center, 3rd Floor
Houghton, MI 49931

Reset Form

Exemption Request and/or Limited Review

Federal regulations (45 CFR 46) permit the exemption of some types of research from IRB review.
Exemption does not mean that you do not need to submit a study for review; our office requests information about your study and will determine the level of review required for approval.
If you have any questions, feel free to contact our office.

Eligible for Exemption: There are several classifications of research which may involve human subjects but their classification falls outside of the IRB's policies and jurisdiction.

Determination that research is exempt or requires limited Institutional Review Board (IRB) review is made through the Office of Compliance, Integrity, and Safety. Exemption from review is only available to certain categories of research as define by federal regulation. If you have questions about whether your project might qualify for exemption, please contact our office.

Project Title	Institutional Ethnography Analysis of Policy and Innovation Labs		
Project Start Date	March 1, 2021 or when approved	Project End Date	December 31, 2021
Principal Investigator	Dr. Angie Carter	Department	Social Sciences
E-mail	ancarter@mtu.edu	Phone	906-231-6293 cell / (906) 487-1431

I. Project Description

1. Purpose and goals of the research:
(text field will expand)

This purpose of this project is to identify how policy innovation labs are working to address current social problems. We propose to conduct interviews with researchers currently involved with these labs to identify how their research is informed by and institutional ethnography

2. Methods and procedures: Describe in detail what subjects will be asked to do, what information will be collected about them, and when or how often research procedures will be conducted. You may also upload an attachment describing the methods including a graph, table, timeline of events.

3. Research Site:

We will conduct virtual interviews with researchers at policy labs identified through our ongoing research. We will begin with interviews with researchers at regional policy lab located in our Great Lakes region, the Lake Superior Living Learning Lab Network, located at regional hubs in Duluth, Thunder Bay, and Sault Ste. Marie.

4A. Will you obtain identifiable private information about these individuals? ◉ Yes ○ No

Private Information includes information about behavior that occurs in a context in which an individual can reasonable expect that no observation or recording is taking place, or information provided for specific purposes which the individual can reasonably expect will not be made public (e.g. student record).

Identifiable means that the identity of the participant may be ascertained by the investigator or associated with the information (e.g. by name, code number, pattern of answers, etc.)

4B. Will data be collected and stored in a manner such that participants may be individually identified directly or indirectly? ◉ Yes ○ No

5. Does the study present more than minimal risk to the participants? ○ Yes ◉ No

Minimal risk means that the risks of harm or discomfort anticipated in the proposed research are not greater, considering probability and magnitude, than those ordinarily encountered in daily life or during performance of routine physical or psychological examinations or tests. Note that the concept of risk goes beyond physical risk and includes psychological, emotional, or behavioral risk as well as risks to employability, economic well being, social standing, and risks of civil and criminal liability.

If Yes, you can not use this form, please submit a Protocol Document

6. Is this a graduate level research project? ○ Yes ◉ No

II. Exemption Categories

Check the category or categories which apply and respond to the questions within that exemption section:

☐ **Category 1**: Research, conducted in established or commonly accepted educational settings that specificially involves normal educational practices that are not likely to adversely impact students' opportunity to learn required educational content or the assessment of educators who provide instruction. This includes most research on regular and special education instructional strategies, and research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.

a) Describe the established or commonly accepted educational setting of the research:

b) Could the research adversely impact student achievement in anyway? ○ Yes ○ No

If Yes, the study does not qualify under this category

c) Could the research adversely impact the assessment of educators who provide instruction? ○ Yes ○ No

If Yes, the study does not qualify under this category

d) Does the research involve a comparison of a proven educational technique to a novel technique? ○ Yes ○ No

If Yes, the study does not qualify under this category

☒ **Category 2:** Research that only includes interactions involving education tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior (including visual or auditory recording) if at least one of the following criteria are met:

☐ The information obtained is recorded by the investigator in such a manner that the identity of the human subjects cannot readily be ascertained either directly or through identifiers linked to the subjects (e.g., anonymous survey);

☒ Any disclosure of the human subjects' responses outside the research would not reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, education advancement, or reputation;

a) Does the research involve minor participants? ○ Yes ◉ No

b) If yes, does the research involve surveys? ○ Yes ◉ No

If yes to b, exemption category 2 does not apply. Complete a Protocol Document and submit for expedited review.

☐ The information obtained is recorded by the investigator in such a manner that the identity of the human subjects can readily be ascertained either directly or through identifiers linked to the subjects, and disclosure has risks, **then an IRB limited review will be conducted to ensure privacy and confidentiality of subjects**. This category may NOT be applied to research with children.

a) Does the research involve an intervention? ○ Yes ◉ No

Intervention is defined as, "manipulations of the subject or the subject's environment that are performed for research purposes."

If yes, exemption category 2 does not apply

☐ **Category 3:** Research involving benign behavioral *intervention** in conjunction with the collection of information from an adult subject through verbal or written responses (including data entry) or audiovisual recording if the subject prospectively agrees to the intervention and information collection and at least one of the following criteria is met:

A) The information obtained is recorded by the investigator in such a manner that the identity of the human subjects cannot readily be ascertained, directly or through identifiers linked to the subjects;

B) Any disclosure of the human subject's response outside the research would not reasonable place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, educational advancement, or reputation; or

C) The information obtained is recorded by the investigator in such a manner that the identity of the human subjects can readily be ascertained, directly or through identifiers linked to the subject, **and an IRB limited review will be conducted to ensure privacy and confidentially of subjects.**

***benign behavioral interventions** are brief in duration, harmless, painless, not physically invasive, not likely to have a significant adverse lasting impact on the subjects, and the investigator has no reason to think the subjects will find the intervention offensive or embarrassing. Provided all such criteria are met, examples of such benign behavioral interventions would include having the subject play an online game, having them solve puzzles under various noise condition, or having them decide how to allocate a nominal

amount of cash received between themselves and someone else.

a) Describe the benign behavioral intervention:

If the research involves deceiving the subjects regarding the nature or purposes of the research, this exemption is not applicable unless the subject authorizes the deception through a prospective agreement to participate in research in circumstances in which the subject is informed that he or she will be unaware of or misled regarding the nature or purposes of the research.

b) Does the research involve deception? ○ Yes ◉ No

c) If so, will subjects prospectively agree to be unaware of or misled regarding the nature of the research? ○ Yes ◉ No

If Yes to B) but no to C), the research will not qualify under this category. You must complete and submit a Protocol Document, you cannot use this form.

Does the research involve minors? ○ Yes ◉ No

If yes, the research does not qualify under this category. You must complete and submit a Protocol Document, you cannot use this form.

☐ **Category 4:** Secondary research for which consent is not required: Secondary research uses of identifiable private information or identifiable bio specimens. **Call our office for assistance.**

☐ **Category 5:** Research and demonstration projects that are conducted or supported by a Federal department or agency, or otherwise subject to the approval of department or agency heads (or the approval of the heads of bureaus or other subordinate agencies that have been delegated authority to conduct the research and demonstration projects), and that are designed to study, evaluate, improve, or otherwise examine public benefit or service programs, including procedures for obtaining benefits or services under those programs, possible changes in or alternatives to those programs or procedures, or possible changes in methods or levels or payment for benefits or services under those programs. Such projects include, but are not limited to, internal studies by federal employees, and studies under contracts or consulting arrangements, cooperative agrements, or grants. Exempt projects also include waivers of otherwise mandatory requirements using authorities such as section 1115 and 1115A of the Social Security Act, as amended.

NOTE: exemption under Category 5 is only permitted upon Federal Agency approval AND after being published on a federal website.

☐ **Category 6:** Taste & food quality evaluation and consumer acceptance studies: (a) if wholesome foods without additives are consumed; or (b) if a food is consumed that contains a food ingredient at or below the level and for a use found to be safe, or agricultural chemical or environmental contaminant at or below the level found to be safe by the Food and Drug Administration or approved by the Environmental Protection Agency or the Food Safety and Inspection Service of the U.S. Department of Agriculture.

Michigan Tech is not currently set up to use these two exemptions categories at this time. Call our office for assistance.

Category 7: Storage or maintenance for secondary research for which broad consent is required.
Category 8: Secondary research for which broad consent is required.

III. Participants, recruitment, and informed consent

1. Describe the proposed participants:

The proposed participants are researchers who are members of policy or innovation labs. They are adults whose work is publicly known as to be aligned with the policy or innovation lab because they are listed on the lab's website.

2. Recruitment: Describe recruitment procedures. Include how participants will be initially identified, approached, or contacted regarding the research and in what setting. *Please provide a copy of any recruitment materials, advertisements, flyers, text of e-mails, etc. which will be used.*

We will recruit members to participate in this study by sending them a recruitment email (attached in this package).

3. Describe procedures for informing participants about the research and how they will actively indicate their agreement to participate. *Please provide a copy of the oral script or information sheet which will be used.*

We will ask participants for oral consent. A copy of the oral script is attached to this package.

4. Compensation/incentives: Will participants or others be offered incentives for their participation (e.g., gifts, payment, reimbursement, services, extra or course credit, or other incentives? ○ Yes ◉ No

If yes, please describe the amount, alternative ways to earn compensation (i.e., in cases of course/extra credit), and when compensation/incentives will be awarded. Please be sure to follow the guidance document, **Procedure for Compensation for Human Subject Participants (found on our website)**.

5. Dual relationships: Does the investigator, co-investigators, or any member of the research team, or anyone assisting with the research have an authority relationship (e.g., instructor/student, employer or supervisor/employee, or other) with potential participants? ○ Yes ◉ No

If yes, describe the relationship, and indicate how the research will be conducted to avoid undue influence on participation

6. Will any aspect of the research be conducted in a classroom setting during class time? ◉ Yes ○ No

If yes, describe what those who choose not to participate will be doing, and provide justification for use of class time for research. *You may be asked to include the course syllabus.*

Madelina DiLisi is doing part of this research as her research credits for the SS 3090 Undergraduate Program for Exploration and Research in Social Sciences course this spring semester 2021. This is similar to an independent study. Madelina has chosen the project and the purpose of the class is to engage in research under supervision of a faculty advisor.

7. Will all participants, their parents/guardians and /or their legally authorized representative (as applicable) be fluent in English? ◉ Yes ○ No

If no, explain how informed consent will be obtained, and provide a copy of the translated documents(s) to be used.

8. If research will be conducted at an international site, indicate the investigator's familiarity with the culture and cultural norms, and how the research may affect an individual's standing in their community ☐ N/A

Some of the research participants may be associated with the Lake Superior Learning Lab Network site in Thunder Bay, Canada. The culture and cultural norms are similar to those across the Great Lakes region in the US.

IV. Instruments

Be sure to upload the questionnaire(s), survey instrument(s), or list of interview or focus group questions to your irbnet.org submission package.

V. Privacy and Confidentiality

1. Privacy: Describe the conditions under which interaction with the subjects will occur (e.g., consent discussion occurs in a private room). Explain how these conditions adequately address the PRIVACY of subject:

Participants will take part in an interview via Zoom video conference call scheduled at a time conveninent to them. The video call will be recorded and transcribed; all data files will be available only to the research team and stored on password protected computer and in a secured shared Google MTU folder. Participants' identities will be confidential; participants' data will be assigned a participant ID number and a participant ID key containing identifiable information (name, contact information) will be stored separately from the data in a secured file.

2. Personally identifiable information: Will the researchers obtain any personally identifiable information (PII) from or about participants (e.g. names, address, telephone numbers, etc.)?

◉ Yes ○ No - (proceed to Question 3)

a) What direct identifiers will be obtained?

Name, phone/email

b) How long will the PII be maintained?

For length of the project

c) Why is it necessary to maintain direct identifiers?

We are analyzing how researchers are working with policy labs to address social problems through policy innovation. Therefore, it is necessary for the research team to know who the researchers are so that we can be sure to recruit people from different types of research groups, different geographic regions, make sure we are interviewing people who have different lengths of time in the work, etc.

d) Describe the coding system that will be used to protect against disclosure of these identifiers.

Participants will be assigned a numerical code for identification and the identification key will be stored separately from the data. Only the research team will have access to the key.

e) How long will the link between identifiers and code be maintained?

For the length of the project

f) Explain how the research will mitigate a risk of participant responses that could place them at risks such as criminal or civil liability, or be damaging to their financial standing, employability, insurability, reputation, or be stigmatizing (e.g. limiting access to identifiers, obtaining a Certificate of Confidentiality from NIH, etc.). *If a Certificate of Confidentiality is obtained, provide a copy to the IRB once available.*

Each participant will have the opportunity to review their interview transcript to make sure that information is correct. Questions ask about their research with the policy lab and do not pose more than minimal risk. Only the research team will have access to the participant key; in coding, analysis and writing of the data, all identifiers will be removed.

3. Will any demographic information be collected which could lead to a deductive disclosure of participant(s) indentifies? If so, how will participant privacy be addressed?

We will collect names and contact information of all participants. Their identities will be confidential, known only to the research team. All identifiers will be removed in the process of coding, analyzing, and writing up data.

4. In what format(s) will the data originate, be shared among team members/collaborators, and be maintained during the life of the study (e.g. paper, digital, electronic media, video, audio or photographic):

There will be audio transcripts and digital recordings of the Zoom calls. Upon transcription, the Zoom digital file of the interview will be destroyed. Upon end of project, the transcripts will be destroyed and the participant key also destroyed. All digital files will be stored on a password protected computer and then immediately uploaded to a secured MTU Google folder available only to the research team.

5. Where will data be stored including security provisions that will be taken to protect the data (include both paper/hardcopy records and digital/electronic files).

Data will be stored on secured, password protected MTU Google shared folder available only to the research team. All materials will be digital files and stored in this folder upon immediate upload from personal password protected computers.

6. Are there potential ethical or legal circumstances when it would be necessary to break confidentiality (e.g., requirements for mandated reporting or other professional obligations to report)? If so, describe:

NA

7. Final disposition: Please describe at what point in time PII and deductive identifiers will be removed from the dataset and/or the records retention plan for the research records:

Identifiers will be removed during the transcription process and prior to coding.

Click here to read instructions on how to submit form

Oral Consent and Question Guide

This is an example of the question guide, which will be modified for each lab to focus on their area of work. The following guide is specific to the Lake Superior Living Lab Network, which is a regional lab working to support food sovereignty and sustainability in the Great Lakes Region, which is where we will be starting in our research. It includes the language for oral consent.

Pre-Interview Script & Oral Consent

Hello, (name here). Thank you so much for meeting with me today. I really appreciate your time and energy and am looking forward to our conversation. Before we begin, I would like to review the consent process with you. I will ask for your oral consent to participate after I've explained the study and asked if you have any questions.

This conversation we will have today is part of a larger study analyzing how policy labs are working to address social problems. I was particularly interested in talking with you today about the Lake Superior Living Lab Network because of your focus on food sovereignty and sustainability across the Great Lakes Region. I will ask you some questions about how the LSSLN works and how your research contributes to this work. All questions are voluntary and you can stop the interview at any time. There is no compensation for taking part in this interview, but your experience will help to inform our understanding of how policy labs work. The interview, with your consent, will be recorded. Then I will transcribe the interview. You will have the option to review the transcript to revise as needed prior to my analysis of the transcript. All digital files will be

stored in secured, password protected files and destroyed at the end of the project. All identifiers will be removed from our data during our analysis. Do you have any questions at this time?

Do you consent to participating in this interview? Do you consent to having the interview recorded?

Great! Let's begin.

Interview Guide

1. Tell me a little bit about yourself: how did you become involved in this research and work?
2. How long have you been studying food sovereignty and food justice?
3. Where do you think your interest in food sovereignty and food justice comes from?
4. I've researched policy labs last semester, and it seems to me like Living Labs are growing in popularity but are still a relatively new phenomenon. Tell me more about how Lake Superior Living Labs Network came to be?
    a. What was the goal in designing Lake Superior Living Labs Network?
    b. How did you first become involved in Lake Superior Living Labs?
    c. For how long have you been involved in Lake Superior Living Labs?
    d. How has Lake Superior Living Labs informed or supported your work?
    e. What do you see as the future of LSSL?
5. Lake Superior Living Labs Network uses place-based research, can you tell me more about this?

    a. How would you say place-based research varies from Hub to Hub?
    b. Why do you think Duluth, Thunder Bay, and Sault Ste. Marie were good candidates for hubs?
    c. What are the benefits of having a network that operates across different geopolitical boundaries? (The US & Canada, Minnesota and Michigan)?
    d. How do you engage or interact with communities? with civic leaders? with policy makers?
6. What challenges have you experienced either within individual hubs or with cross hub coordination?
7. What some of the achievements that you're most proud of within the network? Or what has worked really well?
    a. How has the work of the network helped to support food sovereignty?
    b. What
8. Lastly, what advice do you have for communities looking to strengthen food sovereignty?

Post-Interview Script

Thank you again for meeting with me & sharing your time and knowledge. I can't wait to see what else the LSLLN does in the future. I will be transcribing this interview and using it in my research that seeks to understand how living labs such as the LSLLN can strengthen food sovereignty within communities. Is it okay if I reach out again if I need any clarification on anything? Would you like to review your transcript once it is

available? Lastly, would you be interested in seeing the final research project that this interview is contributing to in the future?

Once again, I really appreciate you meeting with me. If you have any questions or concerns regarding your interview or my research please feel free to contact me.

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Broad Concepts in Local Context: Connecting Living Lab Studies

The two empirical chapters in my thesis aim to provide two perspectives on the living lab methodology at two different scales. The VOSviewer bibliometric analysis and the Lake Superior Living Labs Network case study complement one another by providing quantitative and qualitative data which helps to frame the conceptualization and application of the living lab methodology. The VOSviewer bibliometric analysis provides a broad overview of trends in the living lab literature, identifying key concepts and common applications. VOSviewer illustrates quantitative results using co-occurrence frequency counting methods, which are then interpreted and discussed in the context of the literature review. Meanwhile, the LSLLN case study provides qualitative data to better understand how the living lab methodology is applied in a local context. Each empirical study demonstrates how Dekker et al.'s (2020) four core elements are represented broadly in the literature and in a local application. The importance of these findings is reiterated throughout this thesis as it furthers the conceptualization of living labs with accuracy. However, this section focuses primarily on similarities between the VOSviewer findings and the LSLLN findings in regard to areas of study and the "co-" paradigm.

First, the LSLLN aligns with some of the most recent applications of living labs identified in the VOSviewer network. The overlay visualization feature in the VOSviewer network maps out the temporal distribution of topics trending in the living lab literature over the last five years. The overlay feature in Figure 2 highlights that topics relaing to sustainability and education started to emerge in the living lab literature in 2020. This was developed further into 2021 and 2022, with key terms such as sustainable

development goals, sdgs, higher education institution, food system, agroecology, land, and water. The LSLLN was established in 2019 with the goal of addressing issues at the nexus of water, land and food, climate and energy, and individual community well-being (Portinga et al., 2023). The LSLLN emerged along the same timeline that sustainability initiatives started taking place in higher education institutions in the broad living lab literature. However, one thing that is interesting to note is that the LSLLN may have been ahead of the curve in addressing food systems issues at its start in 2019. Food systems, agroecology, ecosystem services, land and water didn't become a broad trend in publications until 2022 according to the VOSviewer findings. The VOSviewer co-occurrence network identifies keywords to food systems work with growing importance: farmer (n=10), food (n=16), food system (n=10). However, the majority of these applications are rooted in European networks. This speaks to the unique characteristics of the LSLLN and their potential to act as a case study that other living labs and universities can learn from.

There are also similarities in the methods used by LSLLN and the methods referenced throughout the VOSviewer co-occurrence network. The LSLLN notes that they engage academics from a variety of disciplines with backgrounds in community-based and participatory action research methods (Galway et al., 2021), which can also be found in the VOSviewer networks. The VOSviewer findings point to participatory research methods with terms such as participatory design (n=5), participatory action research (n=5), participant observation (n=5), and citizen participation (n=5). Additionally, the aspect of local community engagement and the region is also represented in both the LSLLN and VOSviewer findings. While the

majority of the VOSviewer findings support living labs in an urban context, there is evidence of labs at the rural scale with the term rural area occurring over ten times throughout the literature. Again, this speaks to the unique character of the LSLLN's location and application.

Finally, there is evidence to suggest that the "co-" paradigm plays a role in the conceptualization and application of living labs in the broad literature and in the LSLLN. At the broad scale, co-production severely outweighed the presence of co-creation in the VOSviewer networks. Co-production is strongly associated with public sector innovation and public administration, while co-creation is associated with a variety of disciplines but many home based healthcare solutions. However, language that points to the three co-paradigm concepts is prevalent throughout the VOSviewer network including terms such as collaborative process, citizen engagement, user involvement, user community, inclusion, collaborative approach, design process, participatory design, and much more. The LSLLN explicitly acknowledges co-creation, but also participates in co-production through longstanding resources provided to the community. The emergence of co-production concepts is a key finding of my thesis because it points to living labs engaging in more than just co-creation. Furthermore, it demonstrates that researchers are using these "co-" paradigm concepts in different fields, which suggests that these are distinguished concepts that can enhance clarity when talking about the methods used to engage civil society. The concept of co-design is not explicitly present in the VOSviewer findings or the LSLLN findings, but again there is language that points to iterative design processes where users are included. Still, there needs to be more research done to better understand the role of co-desgining solutions in living labs. Perhaps, co-design principles

are less aligned with social and environmental sciences and public administration living labs and more aligned with technocratic applications of living labs.

Conclusion

The living lab methodology is a promising new research approach that can act as a catalyst for change in a wide range of disciplines. One of the primary benefits of the living lab methodology is that it is flexible and adaptable– allowing researchers to apply it to nearly any place or social issue. However, the flexibility and wide range of living labs have likely contributed to the fragmented conceptualization of living labs. My thesis set out to understand how living labs are discussed at two different scales, providing a broad overview and a local perspective. My findings from the VOSviewer bibliometric analysis and my case study of the LSLLN reiterate key elements of living labs as identified by Dekker et al., (2020). I demonstrate that living labs are consistent in their application of the following four elements: "(1) living labs utilize a research and development process of innovation; (2) living labs collaborate between multiple stakeholders; (3) living labs take place in a real-life setting, and (4) living labs involve users as co-creators." (p. 1210) Reiterating Dekker et al's findings is important for the conceptualization of living labs because it remains one of the most concise and accurate descriptions of the living lab methodology to date, despite prior efforts for nearly a decade.

Furthermore, my work contributes to the conceptualization of living labs by pointing out the hidden role of the "co" paradigm in my findings. By pointing out the hidden role of the "co" paradigm in living labs, we can encourage researchers to be thoughtful about the way they talk about collaboration and what that means for the

broader conceptualization of this developing research method. This also provides an opportunity for researchers to ask how co-creation, co-design, and co-production differ from or contribute to other user-focused research methods such as community-based research and participant action research methods. The development of the living lab methodology can benefit greatly from being able to identify what concept of the "co-" paradigm is being applied as it demonstrates the expectations, timing, and outputs derived from intentional collaboration with users. Even with the absence of "co-" design concepts, the "co-" paradigm holds important implications for understanding the true scope of the living lab methodology and its potential to engage in collaborative community change. Every attempt that gets researchers closer to an accurate description of the living lab methodology shifts it from an ambiguous buzzword to a credible research approach.

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