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FROM URBAN LIVING LAB TO URBAN TRANSFORMATION

A case study of the impact of the living lab on the municipality's capacity for
urban sustainability transition

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ABSTRACT

This thesis investigates the effective implementation of living lab-driven technological solutions within urban contexts, with a focus on the Municipality of Maia's sustainability transition. This research, informed by the author's first-hand experience during an internship with EU-funded projects, uses the Municipality of Maia and the city of Leipzig within the SPARCS consortium as case studies. The European Commission's Innovation and Networks Executive Agency, under Grant Agreement number 864242, supports the SPARCS project coordinated by *Teknologian tutkimuskeskus VTT Oy* (VTT).

An in-depth qualitative analysis, including interviews with key stakeholders like Nadja Riedel from Leipzig and Joao Medina from SPI, coupled with document analysis and the Morgenstadt Model application, reveals the complexities and challenges of integrating sustainability into urban development. The research identifies strengths such as Maia's emphasis on co-creation, stakeholder engagement, and long-term strategic planning. However, it also highlights significant gaps, such as co-creation challenges and insufficient building refurbishment rates.

Comparative analysis with Leipzig provides valuable insights into successful sustainability practices and underscores the need for comprehensive policy frameworks, stakeholder engagement, and robust data monitoring systems. The thesis concludes that while Maia has made strides in sustainable urban development, addressing identified gaps could enhance its transformation. Future research is recommended to focus on reasons behind co-creation and refurbishment challenges, potentially within the scope of the H2020 projects.

This work contributes to the discourse on urban sustainability transitions, offering a roadmap for cities like Maia to navigate the complex journey towards becoming carbon-neutral communities.

SOMMARIO ESTESO

Questa tesi esamina l'implementazione delle soluzioni tecnologiche guidate dai living lab in contesti urbani, concentrandosi sulla transizione verso la sostenibilità del Comune di Maia. Il lavoro di ricerca, ispirato dall'esperienza diretta dell'autrice durante lo svolgimento di un tirocinio con progetti finanziati dall'UE, si avvale dei casi di studio del Comune di Maia e della città di Lipsia all'interno del consorzio SPARCS. Il progetto SPARCS, supportato dall'Agenzia Esecutiva per l'Innovazione e le Reti della Commissione Europea (numero di contratto 864242) e coordinato dal *Teknologian tutkimuskeskus VTT Oy* (VTT), mira a facilitare la transizione urbana sostenibile.

Attraverso un'analisi qualitativa approfondita, che include interviste con testimoni chiave come Nadja Riedel di Lipsia e Joao Medina della SPI, e l'analisi di documenti e l'applicazione del Modello Morgenstadt, la ricerca rivela le complessità e le sfide dell'integrazione della sostenibilità nello sviluppo urbano. Lo studio identifica alcuni punti di forza delle strategie locali, come l'enfasi di Maia sulla co-creazione, l'impegno degli stakeholder e la pianificazione strategica a lungo termine. Tuttavia, evidenzia anche alcune lacune significative, legate alle sfide poste dalla co-creazione e ai problemi legati alla ristrutturazione degli edifici.

L'analisi comparata con Lipsia fornisce spunti di riflessione preziosi sulle pratiche di sostenibilità di successo e sottolinea la necessità di elaborare strategie politiche integrate, coinvolgimento degli stakeholder e sistemi 'robusti' di monitoraggio dei dati.

La tesi giunge alla conclusione che, sebbene Maia abbia compiuto progressi nello sviluppo urbano sostenibile, essa deve ancora affrontare le criticità precedentemente identificate per migliorare la sua trasformazione. Si raccomanda che la ricerca futura si concentri sulle ragioni dietro le sfide della co-creazione e del rinnovamento degli edifici, potenzialmente nell'ambito del progetto H2020 "EHHUR" (Eyes, Hearts, Hands for Urban Revolution).

Questo lavoro contribuisce al discorso sulla transizione urbana verso la sostenibilità, offrendo una mappa stradale per città come Maia per navigare il complesso percorso verso la trasformazione in comunità a emissioni zero.

INTRODUCTION

The concept of sustainability transition has gained significant global attention, emerging as a key agenda in international politics. Local governments across the globe are grappling with the imperative of sustainability in all levels of local, political, and national contexts. As a result, the challenges of adaptation and integration of new regulations, technologies, and innovative initiatives into urban development perspectives have become increasingly prominent. The challenges encountered within organizations to effectively adapt and integrate these new sustainability measures have highlighted the complexity and significance of addressing sustainability at the local level. The compelling issue of sustainable urban development, and more specifically, the role of living labs in driving this transformation, forms the cornerstone of this research.

This research is motivated by the author's first-hand experience during an internship with EU-funded projects at Sociedade Portuguesa de Inovação (SPI) in Portugal and a personal drive to contribute to the environmental well-being of our cities from 06.06.2022 to 01.09.2023 facilitated by the European Commission's Innovation and Networks Executive Agency under the Grant Agreement number 864242 for the SPARCS project — H2020-LC-SC3-2018-2019-2020/H2020-LC-SC3-2019-ES-SCC.

By examining the Municipality of Maia as a case study, this research aims to shed light on the organizational barriers and strategies necessary for successful sustainability transitions within an urban context. The BaZe-Maia Living Lab project aims to develop, implement, and test innovative solutions for decarbonization, assessing their potential for scalability and replication within the municipality. However, the implementation of such living lab-driven technological solutions comes with its own set of challenges, including ongoing projects, procurements, and the unexpected disruption caused by the COVID-19 pandemic. To address these obstacles and expedite progress, the Municipality of Maia has joined the SPARCS project consortium, which is funded by the European Union's Horizon 2020 program.

The SPARCS project, coordinated by *Teknologian tutkimuskeskus VTT Oy* (VTT), is an initiative titled 'Sustainable energy Positive & zero cARbon Communities'—'SPARCS', which commenced on 1 October 2019 and is set to run for 60 months. The SPARCS project entails the formulation of a Sustainable Energy Action Plan (SEAP) for Maia, outlining a series of technical actions to be undertaken between 2019 and 2024. The SEAP focuses on transforming residents' behaviours and habits, increasing energy efficiency, and reducing waste in residential

and commercial structures, the transport sector, and public lighting. This collaborative effort seeks to empower Maia's capacity for urban sustainability transition and drive its transformation into a carbon-free community.

Against this backdrop, this thesis aims to investigate the factors influencing the effective implementation of living lab-driven technological solutions in an urban context to suggest strategies for overcoming the challenges and barriers faced by the municipality. This thesis aims to enrich the body of knowledge regarding urban sustainability transitions and to provide insights that could support the effective advancement and replication of such initiatives in other cities undergoing similar processes of sustainable transformation. The ultimate goal is to facilitate knowledge transfer and foster the integration of regulations, technologies, and innovative initiatives into Maia's urban development perspective.

During my internship, my role involved:

- Engaging with various facets of the SPARCS project, particularly those impacting the Municipality of Maia, and how they align with broader sustainability objectives.
- Participating in the collection and analysis of data relevant to the municipality's efforts in transitioning towards sustainable and carbon-neutral operations.
- Contributing to the assessment of technological and policy-based solutions proposed and tested within the urban context of Maia.

Additionally, I had the privilege of interviewing key project members who offered invaluable perspectives on sustainability transitions in urban settings:

Nadja Riedel, Senior Project Manager at the Leipzig Municipality (LHC), provided insights into the strategies and challenges of implementing SPARCS initiatives in Leipzig, as well as comprehensive overview of the implementation process of Smart City initiatives in the Municipality's organizational structure, enhancing my understanding of the project's impact at a city level and its potential for broader application.

João Medina, Senior Project Manager at SPI, provided a detailed exploration of the project's objectives, as well as insightful examination of the Municipality of Maia's capacity, work culture, and dynamics. His input significantly contributed to addressing several research

questions, shedding light on the inherent challenges and proposing potential approaches to overcome them.

These interviews have afforded me a nuanced view of the collaborative efforts across different municipalities and the shared challenges and successes experienced by the consortium partners. The insights gained from these discussions have been instrumental in shaping the analysis presented in this thesis.

My involvement with the brought to light the intricate challenges that local governments face in the sustainability transition. Witnessing these challenges sparked a curiosity to delve deeper into how cities can overcome barriers and effectively integrate new technologies and innovative practices into their development plans.

This curiosity, coupled with a sense of responsibility towards fostering sustainable communities, guided my exploration into the Municipality of Maia's journey. The city's commitment to becoming carbon-neutral and its active steps towards this goal are both inspiring and instructive. Through this thesis, I have sought to understand the nuances of this endeavour and to distil insights that may benefit others in similar pursuits.

It is my hope that this research not only illuminates the path Maia is charting towards sustainability but also resonates with other urban areas working towards the same vision. May this thesis contribute to the broader conversation on sustainable urban development and encourage continued progress in this essential field.

In this journey of inquiry and discovery, my heartfelt appreciation goes out to a host of individuals whose support has been the backbone of this work. I am profoundly grateful to the municipal representatives, particularly Nadja Riedel, whose insights have been invaluable. My colleagues at SPI, especially my mentors João Medina, Nino Gomes and André Almeida, who deserve special mention for their unwavering support and guidance.

My academic endeavours have been greatly enriched by the wisdom and availability of my supervisor, Giorgia Nesti, and my esteemed professors, Chiara Rabbiosi and Anna Girlado at UNIPD, who have provided me with guidance not only in academic pursuits but also in personal growth, enhancing my time in Italy and making it unforgettable.

Finally, the foundational pillar of my life, my family, has my deepest gratitude. Their unshakeable belief in me and their encouragement to chase my dreams have been the light through all challenges faced.

I must emphasize that the observations, analyses, and conclusions presented in this thesis are my own and do not necessarily reflect the official policy or position of the SPI, the European Commission, the Innovation and Networks Executive Agency, the SPARCS consortium, or any of its members, including the coordinator, VTT. This thesis is a scholarly submission and does not constitute an official report of the SPARCS project.

CHAPTER 1 - LITERATURE REVIEW AND THEORETICAL FRAMEWORK

1.1 Living Labs: History and characteristics

The concept of Living Labs (LLs) has its roots in the late 20th century, although the term itself emerged in the early 2000s. The term "Living Lab" was first coined by William J. Mitchell at the Massachusetts Institute of Technology (MIT) in the early 2000s. It referred to an environment where users, researchers, and industry partners co-create and test new technologies, products, and services in real-life settings (Eriksson & Kulkki, 2005).

The history of Living Labs can be traced back to several related developments in research and innovation, including user-centered design, participatory design, and real-world experimentation. For what concerns user-centered and participatory design, in the 1970s and 1980s, the Scandinavian approach to system development emphasized the involvement of end-users in the design process. This marked the beginning of participatory design, which aimed to engage users actively in the development of products and services, ensuring that the final outcomes were tailored to their needs and preferences (Ehn, 1988). The 1990s saw an increasing interest in conducting research in real-world settings, which led to the development of concepts like living laboratories and real-world experiments. These approaches aimed to bridge the gap between laboratory-based research and practical applications by testing innovations in real-life environments (Brown, 1992; Fischer, 2001).

In the early 2000s, the concept of open innovation gained prominence, emphasizing the importance of collaborative and distributed innovation processes that involve multiple stakeholders and the traditional closed innovation model, where innovation happens within the boundaries of the firm, is no longer sufficient for driving growth and staying competitive. This idea encouraged the establishment of innovation ecosystems, which became a key characteristic of Living Labs. The Living Lab approach quickly gained traction in Europe, with the European

Network of Living Labs (ENoLL) established in 2006 to support and promote the development of Living Labs across the continent.

Hundreds of living lab facilities have been built from 2002 onwards user-centered, open-innovation ecosystems that mix research and cutting-edge processes, frequently through public-private partnerships. As of November 2015, almost 400 LLs were dynamic affiliates of the European Network of Living Labs, or ENoLL (Grotenhuis, 2017). Living Labs provides the users and professionals with a setting in which they can cooperate to develop new goods and services using ICT-based technologies publicly. Furthermore, because of their emphasis on user engagement, Living Labs are also being more integrated into the smart-city strategy taken by many governments (Nesti, 2017). As such, LLs have been increasingly recognized as a valuable approach for supporting the transition towards more sustainable urban environments. LLs provide a space for co-creation and co-learning, bringing together multiple stakeholders, including government, academia, industry, and the community, to test and evaluate innovative technologies and solutions in a real-world setting. By emphasizing the interaction between people and place, LLs can support the development and implementation of innovative solutions that address challenges and opportunities related to urban sustainability transition (Frantzeskaki et al., 2018). Technology and data can be leveraged to create a sustainable and inclusive urban environment by focusing on the needs of its citizens. They can generate significant value in terms of improving quality of life, reducing environmental impact, and creating economic opportunities. (Baccarne et al., 2014). In general, the adoption of LLs involves transformational and technological process that leads to significant changes in existing urban regimes and infrastructure components (Margherita et al., 2020).

Living Labs (LLs) have several distinct characteristics that differentiate them from traditional research and development approaches. These characteristics have been identified and discussed in various studies, which are outlined below:

Co-creation and Collaboration: By incorporating individuals in the co-creation and testing of collaborative innovative solutions in real-world scenarios, LLs provide a viable method to innovation. This open and citizen-centric approach can help in the creation of more user-friendly, sustainable, and relevant solutions, while also lowering the risk of failure and increasing user adoption and satisfaction (Kareborn & Stahlbrost, 2009). The collaborative approach between various stakeholders results in co-production of innovative solutions to various problems. LLs have proved the capacity to develop new knowledge, ideas, and solutions

that address urban needs and challenges. They are intended to be inclusive, allowing people, marginalized groups, and other parts of society to participate in finding solutions to their problems (Nesti, 2018). This exchange of knowledge enhances the feasibility and adoption rates of the proposed solutions in the real world (Leminen et al., 2012). This characteristic ensures the success of Living Lab initiatives (Veeckman et al., 2013).

Real-world setting, experimentation and learning: LLs can function as a supplementary instrument alongside traditional scientific research methods, providing a more inclusive and adaptable research approach that caters to societal needs. They provide a way to bridge the gap between research, policy, and practice, and to test innovative ideas in real-life contexts (Voytenko et al., 2016). They also operate as experimental environments, enabling stakeholders to explore innovative solutions for addressing intricate societal issues within real-world settings. (Schneidewind et al., 2018). They can take a variety of forms, from dedicated physical spaces to temporary installations or events, however, LLs are not just experimental settings for testing innovative solutions but also complex socio-technical systems that require careful governance to ensure their effectiveness and legitimacy (Bulkeley et al., 2016). They have the potential to provide valuable insights into how cities can become more sustainable, resilient, and inclusive and increase the learning capacity of stakeholders (Marvin et al., 2018) encouraging them sharing of ideas, resources, and knowledge between them (Chesbrough H. W., 2004).

Flexibility and adaptability: LLs are known for their adaptability and flexibility, which allows for the co-creation of new solutions and user-driven processes that cater to a variety of scenarios (Schoorman et al., 2018). As experimental spaces, living labs enable stakeholders to adapt and quickly respond to the changing needs of users, citizens, and companies within the innovation ecosystem (Hossain et al., 2019) and addressing the complex and dynamic nature of urban sustainability issues (Nesti, 2018).

Long-term perspective: As innovative platforms for sustainable urban development, LLs place great emphasis on maintaining a long-term perspective. This long-term vision allows living labs to address complex societal challenges more effectively and develop sustainable solutions that consider the changing nature of urban environments (Mulder & Stappers, 2016). By adopting a long-term perspective, living labs can ensure that their initiatives contribute to sustainable development goals over time, rather than merely providing short-term benefits. Schoorman, De Marez, and Ballon highlight the importance of long-term goals and strategies in living lab

initiatives, using the case study of LeYLab, a living lab that focuses on developing sustainable solutions for urban areas (Schuurman et al., 2013). Furthermore, Frantzeskaki & Kabisch (2016) analyse living labs' role in urban environmental governance, emphasizing how living labs contribute to the development of long-term strategies for sustainable urban development through case studies from Rotterdam and Berlin. Such long-term outlook allows living labs to change and adapt to new problems, fostering resilience and enabling continuous innovation in the context of difficult urban challenges (Frantzeskaki & Kabisch, 2016).

Integration of social, environmental, and economic aspects: Living labs serve as vital experimental spaces that integrate diverse aspects of urban sustainability, fostering collaboration among different stakeholders to address complex challenges such as resource efficiency, low carbon solutions, and social inclusiveness (Voytenko et al., 2016). Additionally, they promote transformative action by fostering systemic change, focusing on the interplay between social, environmental, and economic dimensions in the urban context (Nevens et al., 2013).

To summarize, Living Labs provide a distinct and innovative approach to research and development, distinguishing themselves through features such as co-creation, collaboration, real-world settings, experimentation, learning, flexibility, adaptability, long-term perspective, and integration of social, environmental, and economic aspects. LLs may successfully solve complex urban concerns and contribute to sustainable and resilient urban development by embracing these traits, enabling a more inclusive and adaptive research strategy that is sensitive to society's shifting requirements.

1.2 Stakeholders and Actors in Urban Living Labs

Living Labs engage a diverse range of stakeholders and actors to co-create, test, and implement innovative solutions for sustainable urban development. Key stakeholders and actors involved in LLs include:

Citizens: In the context of open innovation, residents, and local communities, can play roles as innovators, co-designers, co-producers, and entrepreneurs in relation to new products and services. Living labs, as a form of open-innovation network, integrate user-centered research and open innovation, providing opportunities for citizens to participate in the innovation process. Additionally, understanding the user needs and involving citizens in the innovation

process to develop business opportunities and competitive advantages are crucial aspects to be considered (Leminen et al., 2012)

Local governments and public authorities: These entities are recognized as critical stakeholders in addressing sustainability issues, especially in the context of climate change mitigation and adaptation. They are seen as potential leaders and effective leverage points for action with regards to major challenges such as climate change and possibly providing the LLs with financial support specially in Europe as the hotspot" for ULLs, supported by dedicated research funding. The paper suggests that ULLs are becoming integral in collective urban governance and experimentation for sustainability (Mahmoud et al., 2021) . City managers have significant purchasing power and can shape individual environmental behaviour through policies on waste collection, water treatment, transportation systems, and building infrastructure facilities. However, notes that despite the necessity and potential of addressing global issues at the city level, there are obstacles to bringing solutions for global issues to the local level (Neuens et al., 2013). Additionally, municipalities play a significant role in the development and implementation of living labs. As key stakeholders, municipal governments actively contribute to the formation of partnerships between citizens, businesses, academia, and other organizations. By providing necessary resources, regulatory support, and strategic guidance, municipalities help shape the direction of living lab initiatives, enabling the co-creation of innovative solutions for complex urban challenges. Their involvement ensures that urban living labs align with local policy objectives and contribute to the broader goal of sustainable urban development (McCormick & Hartmann, 2017).

Private sector and businesses: Living labs act as a mediator between users, public organizations, and private firms, allowing for the identification and exploitation of external sources of knowledge (Schuurman et al., 2013). Furthermore, private sector, through their expertise and resources, can contribute significantly to the development, implementation, and scaling up of innovative solutions for urban challenges. Moreover, the private sector's involvement in living labs can also contribute to economic growth and job creation, as businesses can capitalize on the new opportunities generated by the innovative solutions developed in these labs. This, in turn, leads to a more resilient and sustainable urban environment, benefiting all stakeholders involved (Concilio & Rizzo, 2016). Private sector and businesses often contribute as partners in LLs by providing the prototypes that are essential for testing and development within the living lab environment. Their involvement not only brings

in business insights but also aids in the practical application and refinement of innovative solutions in real-life contexts (Compagnucci et al., 2021).

Researchers and academic institutions: LLs are designed to create, test, and learn from new ideas in real-time, focusing on specific social, economic, and environmental issues in a city. While there are many accounts of LLs from those who have set them up or analysed their effectiveness, there have been fewer critical analyses that look at the bigger picture of how LLs fit into overall urban development strategies and what their consequences and implications are (Bulkeley et al., 2016). Universities and researchers are initiating innovation activities to trial alternative future visions of local economic development, social cohesion, environmental protection, creative sector expansion, policy evolution, service delivery, infrastructure provision, academic research, and more. They can also provide scientific rigor and expertise to the experimental process, as well as contribute to the evaluation and learning from real-world interventions (Evans et al., 2016).

Non-governmental organizations (NGOs): NGOs play a vital role in supporting urban living lab initiatives by offering resources, expertise, and encouraging community engagement. They can also serve as intermediaries between government, businesses, and citizens, helping to create partnerships and enhance collaboration. Moreover, NGOs contribute to the sustainability of urban living labs by ensuring they are inclusive, transparent, and accountable (Puttick et al., 2023).

Technology providers and start-ups: Living labs can assist start-ups and innovative businesses in developing innovations that cater to user requirements and can rapidly expand to international markets. These labs can support companies in swiftly commercializing and scaling their innovations for global distribution. By comprehending the various types of living labs and their attributes, businesses can pinpoint the driving forces behind innovation, foresee probable outcomes, and determine the most suitable role to assume during the "living labbing" process.(Leminen et al., 2012)

Urban planners and designers: Urban areas are increasingly being recognized as ideal innovation arenas by various stakeholders, including urban planners, universities, and technology companies, who collaborate in urban living lab settings to develop and test innovative ideas. Unlike generic living labs that mainly focus on fostering interactions between end-users and private actors, urban living labs emphasize urban or civic innovation, involving a more prominent role for urban planners. These living labs often maintain close relationships

with local governments and place a strong emphasis on social value creation, civic engagement, and non-commercial activities. In this context, urban planners play a crucial role in guiding and shaping the development and implementation of innovative solutions within urban living labs, ensuring that these initiatives are aligned with the broader goals of sustainable urban development and social well-being, since they are deeply and actively involved from the early project stages, and their participation goes beyond adding a reference group to a traditional research project (Chron er et al., 2019).

Financial institutions and investors: The emergence of urban living labs as a form of collective urban governance and experimentation to address sustainability challenges and opportunities has been created by urbanization and needs the financial stability to perform effectively (Voytenko et al., 2016). The availability of resources, including financial resources, is important for the success of urban living labs in promoting policy integration. External funding can be used to hire facilitators and designers to help create new ideas, and to enable experimentation and collaboration among stakeholders. However, the dependency upon external funding streams can also lead to a narrowing of integrative policy goals in order to meet the requirements of the funding bodies. Therefore, the combination of investors and funding sources to finance the living labs is a fundamental aspect of their sustainability (Willems et al., 2022).

International organizations and networks: International networks and organizations, such as the European Network of Living Labs (ENoLL), are vital for living labs as they contribute to standardizing methods and tools across various sites. Launched in 2006, the European Network of Living Labs brought together an initial 20 Living Labs, later expanding to include another 20 Living Labs in its 2nd wave. Through projects like CoreLabs, these networks work on standardizing methods and tools to maximize the synergy potential among different Living Lab sites. This standardization ensures a more consistent and effective approach to innovation, facilitating unobtrusive interaction with end-users. Consequently, companies can benefit from the unique opportunity provided by living labs to involve end-users in the new product development process, making international networks and organizations vital for their success. (J. Schumacher & K. Feurstein, 2007).

1.3 Types of living labs

Living laboratories are classified according to which actor drives their operations, and four categories are proposed: utilizer-driven, enabler-driven, provider-driven, and user-driven. In this context, the key difference between users and utilizers in this context is that utilizers are companies focusing on business development through living labs, while users are individuals or communities who directly benefit from the solutions developed in user-driven living labs. Utilizer-driven labs are more business-oriented, focusing on product and service development for commercial benefits, whereas user-driven labs are community-oriented, focusing on solving real-life problems of the user communities. Each kind of these categories has a particular player who is more engaged in the early stages or later functions as the primary promoter of innovative activities. Here is a brief definition of each group:

1. **Utilizer-Driven Living Labs:** In utilizer-driven living labs, companies initiate and promote the labs to develop their businesses. The focus is on developing and testing the company's products and services. These living labs primarily create value for utilizers, as their activities are geared towards achieving objectives and concrete outcomes that benefit the utilizer's operations. The utilizers use these labs strategically to gather data on users or user communities to inform their business development.
2. **Enabler-Driven Living Labs:** Enabler-driven living labs are typically initiated by public-sector actors, non-governmental organizations, or financiers such as towns, municipalities, or area-development organizations. They focus on societal improvements and are driven by regional or societal needs, such as reducing local unemployment or addressing social and structural problems. Enablers have the largest interest in these labs, and the activities aim for far-reaching results, like regional development.
3. **Provider-Driven Living Labs:** Provider-driven living labs are launched by developer organizations like educational institutes, universities, or consultants. These labs focus on promoting research and theory development, augmenting knowledge creation, and finding solutions to specific problems. They aim to improve users' everyday life, with the benefits of the resulting innovation varying among participants. Provider-driven living labs struggle with attracting enablers and utilizers, and their duration varies based on the project.

4. **User-Driven Living Labs:** User-driven living labs are established by user communities to address their everyday-life problems. They focus on solving specific issues that align with the values and requirements of users and user communities. The value is mainly created for the user community, but companies and society benefit indirectly. These labs are long-lived, built around the user community, and characterized by a bottom-up principle. Other actors in the network support users by providing resources, knowledge, equipment, mentorship, or guidance.

The categories' goals, value-creation reasoning, and outputs differ. Understanding the variations between the various types of living laboratories assists actors in selecting what they want to achieve and then building or joining living labs of a certain type to achieve their own goals. Participation in living labs may also assist corporations in developing innovations that are more suited to the demands of consumers and can be quickly scaled up to a worldwide market (Leminen et al., 2012). Table 1 summarizes the characteristics of living labs based on their specific type.

Table 1: Characteristics of Different Types of Living Labs (Leminen et al., 2012 p.8)

Characteristic	Type of Living Labs			
	<i>Utilizer-driven</i>	<i>Enabler-driven</i>	<i>Provider-driven</i>	<i>User-driven</i>
Purpose	Strategic R&D activity with present objectives	Strategy development through action	Operations development through increased knowledge	Problem solving by collaborative accomplishments
Organization	Network forms around an utilizer, who organizes action for rapid knowledge results	Network forms around a region (regional development) or a funded project (e.g., public funding)	Network forms around a provider organization(s)	Network initiated by users lacks formal coordination mechanisms
Action	Utilizer guides information collection from the users and promotes knowledge creation that supports the	Information is collected and used together, and knowledge is co-created in the network	Information is collected for immediate or postponed use; new knowledge is based on the information	Information is not collected formally and builds upon users' interests; knowledge is utilized in the

Characteristic	Type of Living Labs			
		achievement of present goals		that provider gets from the others
Outcomes	New knowledge for product and business development	Guided strategy change into a preferred direction	New knowledge supporting operations development	Solutions to users' everyday-life problems
Lifespan	Short	Short/medium/long	Short/medium/long	Long

Based on the characteristics presented in the table, the ideal type of Living Lab to promote sustainability transition in urban areas would be an enabler-driven Living Lab. This type of Living Lab focuses on strategy development through action, with the network forming around a region or a funded project. The information is collected and used together, and knowledge is co-created in the network. The outcomes of this Living Lab include guided strategy change into a preferred direction, with a short to long lifespan.

1.5 Implementing Urban Living Labs: Steps and Processes

Implementing a living lab involves a series of steps and processes to ensure that the initiative is successful in achieving its goals. While there may be variations in the implementation process based on the specific context and objectives of each living lab.

The FormIT methodology was developed by the Swedish Botnia Living Lab's team¹ in 2016.

The approach highlights the importance of the initial phase of concept design, known as analyses or requirements engineering, and emphasizes the continual re-examination of users' needs throughout the process. FormIT is an iterative method that fosters knowledge growth through interactions between phases and diverse perspectives. The methodology consists of three iterative cycles: Concept design, Prototype design, and Innovation design, each with three phases covering Use, Business, and Technology aspects. Planning and Commercialization cycles bookend the process. FormIT embodies the five Key Principles of Living Lab operations,

¹ See https://www.ltu.se/cms_fs/1.157454!/file/LTU%20Broschyr%20Botnian%20Living%20Lab%20210x148_lowres.pdf for more details

focusing on possibilities and strengths, and promoting user engagement and cross-functional interaction for innovative ideas.

The FormIT methodology starts with the Planning phase where stakeholders gather information, mix competencies, and consider the five Key Principles of Living Labs. The methodology then moves through three iterative cycles: Concept Design, Prototype Design, and Innovation Design. In each cycle, the focus is on appreciating opportunities, designing, and evaluating, while keeping the Key Principles in mind. The Innovation Design cycle is where the living lab is implemented, and the final service or product is designed based on feedback from users and stakeholders. This cycle involves refining the design, incorporating user experience goals, and considering aspects like sustainability and openness. Finally, the Commercialization phase focuses on introducing the innovation to potential buyers and assessing its market potential, taking into account individual, social, and technological conditions that may influence the adoption and use of the innovation as can be found in Figure 1 below (Ståhlbröst & Holst, 2012).

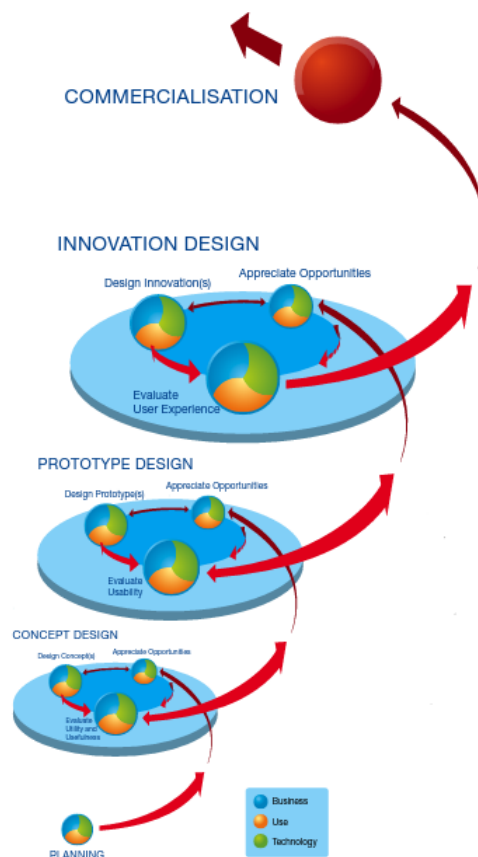


Figure 1: FormIT Methodology (Ståhlbröst & Holst 2012, p. 24)

The planning phase is important to focus on for achieving sustainability transition. This is because during the planning phase, it is essential to gain a deep understanding of the underlying circumstances of the project and mix different competencies to stimulate knowledge sharing and an increased understanding of the involved stakeholders' visions. It is also crucial to keep the five key principles of Living Lab operations in mind during this phase, and to consider how value can be created for the users, how the users can influence the process and innovation, how sustainability takes form, how openness should take form, and how the process should be designed to capture as realistic a situation as possible. The planning phase sets the foundation for the rest of the process, and errors made during this phase become hard and expensive to correct in later stages. This stage is also crucial for building organizational capacity in a municipality for the same reasons.

The second cycle, which is the Prototype Design cycle, is the seed and base point to strengthen the enabler-driven mode of living lab. In this cycle, the focus is on identifying stakeholders' needs in the innovation and co-creating the concept with users. The design of the innovation broadens to include basic functions, workflows, and interfaces, and the evaluation is focused on interaction between the user and the service, including aspects such as how easy it is to learn and how effective and enjoyable it is to use. This cycle is characterized as short, medium or long-term lifespan, depending on the innovation being developed.

1.6 Sustainability Transition and the Morgenstadt Framework

Due to a tremendous change from rural to urban living during the last century, the transition to a sustainable society has become increasingly an urban concern. Cities both generate and solve environmental and social problems. Living Labs are research infrastructures integrated in a real-world setting that have lately emerged as a tool for urban governance and sustainability research to promote innovation toward sustainable urban development (Schliwa, 2013).

According to the World Commission on Environment and Development's definition, "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs"². The Morgenstadt framework is a comprehensive approach to urban sustainability transformation developed by the Fraunhofer Institute for Industrial Engineering IAO³. It includes a set of guidelines and tools

² See <https://eur-lex.europa.eu/EN/legal-content/glossary/sustainable-development.html>

³ See <https://www.morgenstadt.de/en.html>

for cities and municipalities to implement sustainable urban development strategies. The framework is based on the four pillars of sustainability: social, economic, ecological, and cultural. It also takes into account the impact of digitalization on urban sustainability. This methodology is based on the international standards such as ISO 37120:2014-2018 sustainable development of communities, ISO/TR 37150:2014 and ISO/TR 37151: 2015 smart community infrastructure.

The "Morgenstadt / City of the Future Model for Sustainable Urban Development" incorporates the three stages demonstrated in diagram below: Performance indicators, key action fields, and impact factors developed by Fraunhofer-Gesellschaft "Morgenstadt: City Insights." It merges them into a single integrated framework (Figure 2) that not only acts as an analytical tool for systemic urban study, but also aids in understanding the role of technology, regulations, and business models to improving city sustainability (See annex for table of indicators).

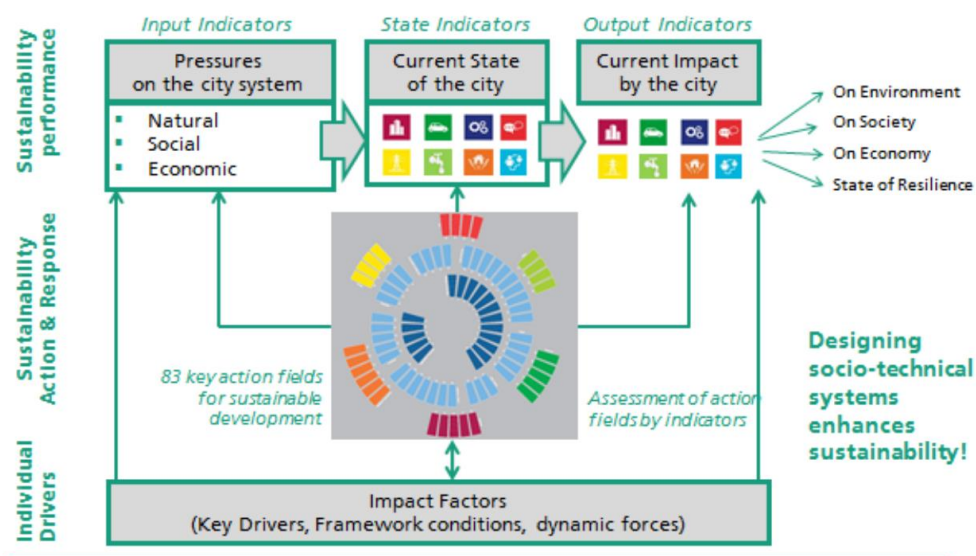


Figure 2: Morgenstadt / City of the Future Model for Sustainable Urban Development (Radecki 2013, p. 19)

As enablers of sustainable urban development, nine essential action fields stand out. They are influenced by several other critical action sectors and hence serve as appropriate beginning points for allowing a shift to improved urban sustainability. These ones are:

- Energetic refurbishment in buildings
- Awareness/Education: Creating awareness of sustainability through the integration of sustainability issues in education and information

- District Management - small-scale use-mix in local districts
- Creation of markets for sustainable products & solutions
- Creation of an atmosphere open to innovation and transformation regarding sustainability
- Communal energy management
- Promotion of renewable energies, Activation of business actors for supporting the sustainability strategy of the city
- Development and implementation of services for supporting sustainability solutions. (Radecki, 2013)

Cooperation and links across diverse sectors such as government, business, and civil society are also critical in order to accomplish the essential acceleration of a transitions toward more sustainable urban systems (Ehnert et al., 2018). Therefore, keeping in mind the characteristics and definitions of Living Labs, the use of them has been identified as a promising approach to address sustainability challenges and take advantage of opportunities arising from urbanization to facilitate this transition. LLs are characterized by their participatory nature, focus on learning and evaluation, and aim to enhance sustainability and promote low-carbon economies (Voytenko et al., 2016). In this regard, the idea of Living Labs has been divided into two research areas, namely Sustainable Living Labs (SLL) and Urban Living Labs (ULL). SLLs focus on developing product and service systems and generating knowledge for future scaling, while ULLs focus on implementing socio-technical innovations in urban areas (Schliwa, 2013). This research will focus on the role of Urban Living Labs to investigate the process of transition into a more sustainable development process by using innovative solutions in urban context and develop the strategies for planning the future.

1.7 Organizational Capacity Building

In general, capacity building refers to the process of enhancing an organization's or community's abilities to identify, develop, and implement effective solutions to achieve their goals and objectives (Eade, 2005). Over the past three decades, municipalities have been addressing climate change through small-scale initiatives, but in recent years, there has been a second wave of municipal action that has included a broader range of cities and a new generation of municipal networks. Municipal networks such as C40 and ICLEI have played a critical role in the governance of climate change in urban areas by providing essential resources,

funding, and normative enterprise, positioning cities as crucial sites for addressing climate change and promoting the strategic importance of urban governance. Municipalities can enhance their organizational capacity for promoting sustainability by adopting several measures, such as setting targets for climate change and renewable energy, implementing energy efficiency incentive programs, advocating for green procurement standards, establishing public transport policies, and engaging in public-private partnership agreements (Bulkeley, 2010). To effectively address climate change in urban areas, it is crucial to create strategic policy and planning documents that explicitly prioritize climate change and target the entire urban region (Reckien et al., 2014).

In this sense, local and regional authorities have a crucial role in implementing policies, programs, legislation, and public investments in areas that are vital for sustainable growth and innovation, such as energy, environment, transport, land-use, education, or social services. In addition to setting the framework, they are responsible for implementing these measures. However, coordinating various policies and different levels of government can be challenging but is essential to accelerate the transition to a greener economy and facilitate collaboration between innovation and environmental actors (Foray et al., 2012). The success of these innovative initiatives depends on stakeholder participation and collaboration in the governance processes. Therefore, Living Labs can play a vital role in creating more inclusive innovative projects by promoting collaboration between public and private actors, leading to the co-creation of new services (Bifulco et al., 2017). Urban Living Labs can be utilized in the domain of organizations and businesses to effectively facilitate innovation processes within companies as well. Consequently, companies will be placing more emphasis on co-operative value-adding that directly integrates the needs and creativity of customers and other stakeholders. Through advanced ICT solutions, these companies access and combine globally dispersed knowledge and form collaborative networks, such as living labs. These networks create the conditions for new types of dynamic, profitable, and positive relationships among the public sector, large companies, and individual entrepreneurs (Eschenbächer et al., 2010).

The capacity for innovative governance should be viewed as a multifaceted construct, which encompasses various levels of power and awareness, ranging from short-term interactions to fundamental ways of implementing governance. To identify socially innovative practices, analysts should examine the underlying frames of reference and cultural practices that shape people's perceptions of their shared world and their day-to-day interactions. Moreover, it is impossible to analyse the role of civil society without considering its relationship to the state,

particularly at the local level. At this level, the state performs several roles, including acting as a legal regulator, a partner in public-private ventures, a protector of the interests of private capital, and a source of resources for the reproduction of various groups within civil society (Moulaert et al., 2005). To continue building capacity for sustainable growth and innovation, the first step is to link the social innovation strategy with the region's smart specialisation strategy. This can be achieved by supporting new and existing organizations, providing training in new methods of idea generation and problem-solving, and adapting financial models. Additionally, strengthening the market for social innovations and encouraging cross-sector collaborations is important, which can be done by leveraging the power of public procurement. Supporting innovators through business support measures and encouraging workplace innovation is also essential. Furthermore, investing in new financing models for each stage of the innovation process and setting up better structures for measuring the results of social innovation are recommended by the European Commission (European Commission, 2013). In addition to these measures, the development of regional Research Infrastructures such as Regional Partner Facilities and Cross Border Facilities can help to concentrate regional human capital, to train and attract international researchers and technicians, and to stimulate the use of science and innovation as a key instrument of regional development in terms of socio-economic return (Foray et al., 2012).

Frameworks of capacity building must address and combine both high and low-intensity approaches. These frameworks should integrate program planning, monitoring, and evaluation, with a focus on building a better understanding of the value of appropriate organizational change. At this level, capacity building activities may include national policy making, legal regulatory action plans, management and accountability systems, and partnerships or networks linking national institutions with local agencies (Nu'Man et al., 2007). Moreover, the following indicators from the Morgenstadt model are related to organizational capacity building and would be relevant for the study:

- Establishment of sustainability advisory boards
- Creation of flat hierarchies within city administration
- Establishment of a learning organisation within the city administration
- Creation of administrative structures for communal sustainability management
- Creation and administration of platforms for citizen participation.
- Training of administrative staff in sustainability issues (Radecki, 2013).

A more systematic approach to address capacity building in organizations can be more effective by implementing a pyramid consisting of nine interdependent components that form a four-tier hierarchy of capacity building needs (Potter & Brough, 2004). This approach emphasizes the importance of structures, systems, staff and facilities, skills, and tools. The nine components in the pyramid are interconnected, and focusing on one component can impact others. Prioritizing systemic capacity building can lead to more efficient and effective resource allocation, and ultimately, improved service delivery. The pyramid presented in Figure 3, includes nine components: performance capacity, personal capacity, workload capacity, supervisory capacity, facility capacity, support service capacity, systems capacity, structural capacity, and role capacity. By identifying the specific capacity building needs of a particular sector or organization, policymakers and managers can better design interventions and allocate resources to achieve long-term and sustainable results. Focusing on systemic capacity building can lead to improved diagnosis of sectoral shortcomings, improved project and program design and monitoring, and more effective use of resources. (Potter & Brough, 2004).

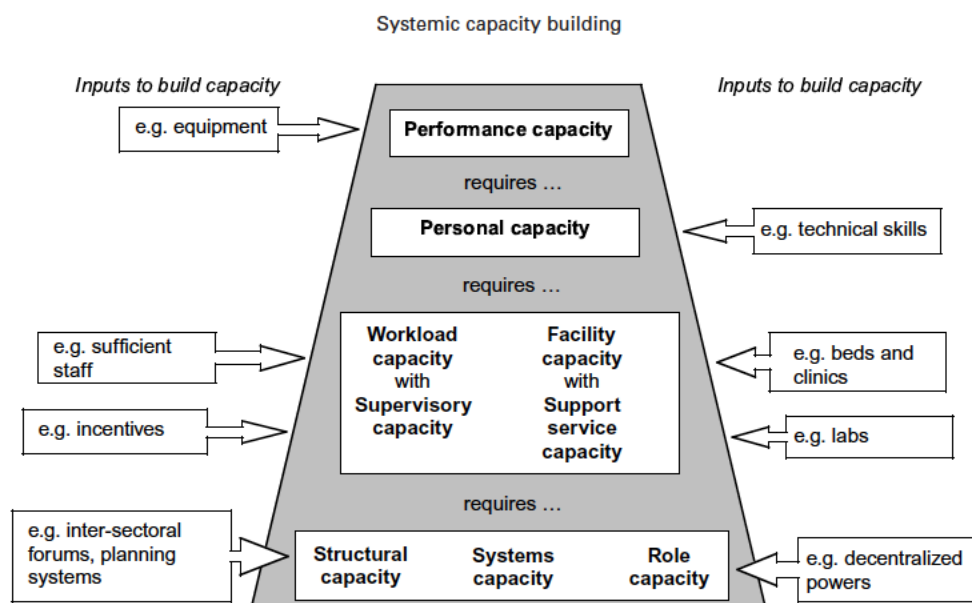


Figure 3: Pyramid of Effective Capacity Building (Potter & Brough 2004, p. 341)

Urban Living Labs, as an organizational form, have the potential to enhance their own capacity and also make valuable contributions to the capacity of public administrations, including municipalities (Bylund et al., 2020) by offering a platform for public agencies to engage with private sector organizations, serving as intermediaries for innovation, fostering an open innovation perspective, which is prioritized over obtaining specific innovation outcomes, addressing scalability and sustainability challenges, which are major concerns for living labs as

intermediaries for open innovation (Gascó, 2017). Additionally, Living Labs are seen as a pioneering tool for urban planning that facilitates the integration of researchers' and policy makers' expertise with the active engagement of local communities (Amenta & Attademo, 2016) as well as serving as a bridge between higher education institutions and the socio-economic fabric of the surrounding area, promoting the establishment of inclusive educational communities that cut across different disciplines (Masseck, 2017).

1.8 Key Challenges and Success Factors

Although living labs hold the potential to promote sustainable urban development, there are several obstacles that can impede the successful adoption of living lab-driven solutions. These hurdles may encompass insufficient resources or funding, ambiguous roles and responsibilities, reluctance to embrace change, and limited community engagement and participation (Hossain et al., 2019). Some of the most challenging barriers to achieving the goal of effective living lab-driven technological solutions in an urban context include:

1. Securing adequate funding for urban living labs can pose a significant challenge due to the substantial resources required for their establishment and ongoing operation.
2. Effectively engaging stakeholders, including local residents, businesses, and government officials, can be demanding, particularly when their initial interest or commitment to the project is lacking.
3. Managing the collection, analysis, and organization of extensive data sets can be a time-consuming and resource-intensive undertaking.
4. Overcoming regulatory obstacles is often encountered by urban living labs, potentially causing delays or hindrances to their progress.
5. Ensuring the long-term sustainability of urban living labs can be complex, particularly if they are not integrated into broader urban planning and development initiatives (Burbridge, 2017).

To overcome these challenges, it is essential for municipalities to embrace suitable strategies and approaches. The prosperous integration of living labs necessitates the alignment of stakeholder interests, efficient communication, and the establishment of a supportive and

cooperative governance framework. By allocating additional resources, outlining distinct governance structures, actively involving the community, and providing training and professional development opportunities, municipalities can help overcome the challenges hindering the effective implementation of living lab-driven solutions. In doing so, they can foster the transition towards creating more sustainable urban environments (Scholl & AlAwadhi, 2016).

1.9 Analytical Framework

In this study, the integration of the literature review and the Morgenstadt framework will be pursued to form a comprehensive academic framework. The literature review serves as a basis for comprehending the current knowledge and research in the topic, while the theoretical framework provides a conceptual framework and analytical lens through which the research issues will be examined. By combining these two elements, the study aims to synthesize relevant theoretical perspectives with empirical evidence to develop a robust and cohesive framework for investigating the research objectives.

As stated earlier, the Morgenstadt framework is organized into three levels of examination: Indicators, Action Fields, and Impact Factors. The indicators level provides measurements of the current state of urban systems, while the Action Fields level assesses the extent of intervention in key areas that promote sustainability. The Impact Factors level identifies specific factors that are distinctive to the city being analysed. By considering all three levels, a comprehensive understanding of a city's current sustainability performance can be achieved. This understanding can then inform the development of coherent strategies and an integrated roadmap for development, taking into account the unique factors that shape the city, such as external pressures, sociocultural dynamics, geographic and historic conditions, and more (Wendt W., et al., 2016).

Concluding from all concepts and frameworks discussed in this chapter, it is possible to extract and classify the categories, criteria and sub-criteria for living labs to increase their organizational capacity building and move towards a sustainability transition as shown in Table 2.

Table 2: Classification of concepts and criteria extracted from the literature

Categories	Criteria	Sub-Criteria
Lab's Characteristics	Co-creation and Collaboration	
	Real-world setting	
	Experimentation and learning	
	Flexibility and adaptability	
	Long-term perspective	
	Integration of social, environmental, and economic aspects	
Participation of Stakeholders and Actors	Citizens	
	Local governments and public authorities	
	Private sector and businesses	
	Researchers and academic institutions	
	Non-governmental organizations	
	Technology providers and startups	
	Urban planners and designers	
	Financial institutions and investors	
International organizations and networks		
Enabler-driven Lab's approach	Purpose: Strategy development through action	
	Organization: Network forms around a region (regional development) or a funded project (e.g., public funding)	

Categories	Criteria	Sub-Criteria
	Action: Information is collected and used together, and knowledge is co-created in the network	
	Outcomes: Guided strategy change into a preferred direction	
	Lifespan: Short/medium/long	
Implementation stages (from FormIT Methodology)	Planning phase	Deep understanding of the underlying circumstances of the project and mix different competencies to stimulate knowledge sharing and an increased understanding of the involved stakeholders' visions
		Influencing the innovation process by users
		Designed to capture as realistic a situation as possible
		Building organizational capacity in planning phase
		Fix the errors in planning phase
		Openness
		Value creation
	Prototype Design	identifying stakeholders' needs
		The design of the innovation broadens to include basic functions, workflows, and interfaces
		evaluation is focused on interaction between the user and the service
Application of the Morgenstadt Model	Sustainability Transition's Principles	Energetic refurbishment in buildings
		District Management - small-scale use-mix in local districts

Categories	Criteria	Sub-Criteria	
		Creation of an atmosphere open to innovation and transformation regarding sustainability,	
		Promotion of renewable energies, Activation of business actors for supporting the sustainability strategy of the city	
		Development and implementation of services for supporting sustainability solutions.	
		Community energy management	
		Creation of markets for sustainable products & solutions	
		Awareness/Education: Creating awareness of sustainability through the integration of sustainability issues in education and information	
	Organizational Building	Capacity	Establishment of sustainability advisory boards
			Creation of flat hierarchies within city administration
			Creation of administrative structures for communal sustainability management
			Creation and administration of platforms for citizen participation.
			Training of administrative staff in sustainability issues

Regarding the Pyramid of Effective Capacity Building, there are several indications that the criteria that outlined in the systemic capacity building framework, are being addressed, although in varied forms. **The establishment of sustainability advisory boards** showcases a commitment to **structural capacity**, ensuring there is a guiding framework for sustainable practices and decision-making processes within the city's administrative body. Similarly, the

concerted efforts to **facilitate platforms for citizen participation** are reflective of building **systems capacity**, which is vital for inclusive and participatory sustainability efforts. The importance given to **training administrative staff in sustainability issues** is a direct investment in **personal capacity**, enhancing the competencies necessary to drive and manage sustainable transformation.

Additionally, while not explicitly defined, initiatives like **collaborative stakeholder engagement**, **co-creative methodologies**, and the integration of **multifaceted sustainability services** imply a bolstering of **workload capacity** with supervisory support and facility capacity with support **service capacity**. These initiatives likely provide the groundwork for enhanced **performance capacity** within the city's sustainability projects. While not directly mentioned, the inputs for **building capacity** such as **equipment and technical skills** are inferred to be part of the broader resource allocation for these projects. The emphasis on creating a Living Lab environment that nurtures **innovation, learning, and adaptability** suggests that Maia is implicitly fostering role capacity by allowing for dynamic roles within the sustainability transition. Thus, even though some criteria may not be explicitly covered, the strategies and actions undertaken by Maia indicate an approach to organizational capacity building, aligning with the core tenets of the systemic capacity building framework. Therefore, to avoid overlapping of concepts and repetitiveness, the Pyramid of Effective Capacity Building was not separately assessed in following sections.

CHAPTER 2 - RESEARCH DESIGN AND RESEARCH QUESTIONS

This chapter outlines the research methodology employed in this study, which is designed to provide a comprehensive understanding of the implementation process of living lab-driven technological solutions in the urban context of Maia. The methodology is structured to address the research questions effectively and to provide actionable insights that can guide the municipality's efforts towards urban sustainability transition.

The research design is rooted in a qualitative approach, focusing on the exploration and understanding of the complex dynamics involved in the implementation of living lab-driven technological solutions. The data collection process involves a combination of interviews, observations, and document analysis, providing a rich and diverse dataset that captures various aspects of the implementation process.

The data analysis process is guided by thematic analysis, a versatile qualitative research method that allows for the identification, analysis, and reporting of patterns within the data. This method involves carefully sorting the data into key categories. These categories are not just simple patterns; they serve as a tool to understand the data more deeply. The process of thematic analysis involves repetitive review of the data, organizing it, and theme development, guaranteeing a comprehensive examination of the dataset (Guest et al., 2014).

The Morgenstadt methodology is employed to assess the capacity of the Maia Living Lab for urban sustainability transformation. This methodology provides a structured framework for building and establishing communities in urban settings, emphasizing the importance of socio-technology as a guiding principle for shaping and managing activities and services in living labs.

A comparative analysis is also conducted to compare and analyse the practical organization and characteristics of living lab research, providing a deeper understanding of the method within a broader research process. This analysis allows for the assessment of the nature of observations within living lab research and the effectiveness and impact of living lab approaches in real-world environments.

The research methodology concludes in a comprehensive gap analysis of the findings from the Maia Living Lab. This analysis identifies areas of strength and areas that require improvement within the living lab's implementation process. Based on these findings, actionable recommendations are proposed to enhance the effectiveness of the living lab and to support the municipality's efforts towards urban sustainability transition.

The following sections provide a detailed description of each component of the research methodology, highlighting the rationale behind the chosen methods and their alignment with the research objectives.

2.1 Research Questions

The research is aimed at analysing the role performed by living-labs as a strategy to promote the sustainable transition in a Municipality of Maia. The main research questions are:

- What factors influence the effective implementation of living lab solutions for sustainable transition in an urban context?
- What are the most challenging barriers to achieving this goal?
- Have living lab been an effective solution in fostering sustainable urban development in Maia?

The research aims to bridge the gap between the theoretical potential of living labs and the practical realities of implementing their solutions in the context of an active, evolving urban landscapes and to contribute to the broader discourse on urban sustainability by offering evidence-based recommendations for other municipalities embarking on similar sustainability journeys.

2.2 Methodology

This section presents the methodology that will be employed to address the research question and objectives of this study. A qualitative research approach will be utilized to gain a comprehensive understanding of the factors that increase the effective implementation of living lab-driven technological solutions in an urban context and to identify the most challenging barriers to achieving this goal. The study will adopt a cross-sectional design, collecting data after the implementation of the living lab project through interview and document analysis.

Semi-structured interviews will be conducted with key stakeholders involved in the Maia living lab and the municipality's efforts for urban sustainability transition, allowing for in-depth exploration of their perspectives and experiences. Data analysis will involve thematic analysis and qualitative coding of the concepts and frameworks mentioned in chapter 1, and comparative analysis of the interview transcript. The Morgenstadt methodology will be employed to assess the current state of the Maia Living Lab's sustainability efforts, including defining objectives, selecting relevant indicators, and conducting a gap analysis. The findings from this research will contribute to the existing knowledge base on living lab implementations and provide practical insights for decision-makers and stakeholders seeking to promote urban sustainability transition.

2.3 Research Design

This study will use cross-sectional data after project implementation collected through interviews observations and the monitoring process of the project. A cross-sectional approach collects data at a single point in time, offering a picture of the elements driving the application of living lab-driven technical solutions in an urban setting. This design is appropriate for investigating the existing state of things and comprehending the contextual aspects that help or impede efficient implementation (Creswell J. David & Creswell John W., 2017). Case study research has two goals: (1) to provide descriptive facts and (2) to develop theoretical connections (Mills et al., 2012) The objective of an explanatory case study is to show how and why certain situations operate as obstacles (Yin, 2018) to implementing innovative solutions in the urban context of Maia city.

2.3.1 Data collection

To answer the research question, a qualitative approach will be used, allowing for an in-depth exploration of the factors influencing effective implementation and the barriers encountered. The following data collection methods will be employed:

Qualitative data will be gathered through semi-structured interviews with key stakeholders participating in the Maia living lab and the municipality's efforts to assist urban sustainability transition, such as municipal authorities and project members. To enable for in-depth study of participants' viewpoints and experiences, interviews will be done utilizing an open-ended questionnaire. Qualitative research is especially well-suited to exploring the elements that

influence the application of living lab-driven technical solutions. It enables a broad grasp of the complexity and dynamics of the implementation process through a deep and nuanced awareness of stakeholders' viewpoints and experiences (Denzin & Lincoln, 2006). Researchers can use qualitative research to investigate people's subjective experiences, perceptions, and interpretations, revealing insight on the underlying elements that drive decision-making, cooperation, and the effective implementation of new ideas (Merriam, 2009). By employing qualitative data collection methods such as interviews and observations, this study can capture the diverse viewpoints, motivations, and challenges faced by key stakeholders involved in the Maia living lab and the municipality's efforts for urban sustainability transition. By conducting in-depth interviews with key stakeholders and engaging in field observations, this qualitative approach will generate a rich dataset that captures the complexity and intricacies of the implementation process.

Because qualitative interviews are open-ended, the researcher has more freedom in probing and researching pertinent themes, allowing the researcher to dive into the stakeholders' viewpoints and experiences in their own words. Patterns, themes, and linkages may be uncovered by thorough analysis of qualitative data, offering significant insights into the elements impacting the effective implementation of living lab-driven technology solutions. Because qualitative interviews are open-ended, the researcher has more freedom in probing and researching pertinent themes, allowing the researcher to dive into the stakeholders' viewpoints and experiences in their own words. Patterns, themes, and linkages may be uncovered by thorough analysis of qualitative data, offering significant insights into the elements impacting the effective implementation of living lab-driven technology solutions (Bogdan, Robet, Biklen, 2007). The relevance of qualitative research approaches in collecting deep and contextual insights into living lab processes is emphasized in the Living Lab Methodology Handbook. It emphasizes the significance of interacting with multiple stakeholders using methods such as interviews, focus groups, and observations in order to understand their perspectives, experiences, and needs. Researchers may use these tools to investigate the complex dynamics of living labs and find the aspects that determine effective implementation (Ståhlbröst & Holst, 2012).

Document analysis involves the systematic examination and interpretation of various documents related to the implementation of living lab projects, such as project reports, policy documents, technical specifications, and project documentation. This method can provide a comprehensive understanding of the contextual factors, project objectives, and strategies

employed in the implementation process. It can also offer insights into the decision-making processes, resource allocation, and the roles and responsibilities of different stakeholders involved in the project. For instance, Almirall et al, conducted document analysis to map the landscape of innovation methodologies, including living labs. They analysed various documents, such as academic papers, conference proceedings, and reports, to identify the characteristics, goals, and practices of living labs. Document analysis helped provide a comprehensive overview of the different types of living labs, their objectives, and their approach to innovation. (Almirall et al., 2012). Same method used in another study of the same author which employed document analysis to examine the role and applicability of living labs in the context of open innovation. They analysed documents from various living lab initiatives, including project reports and case studies, to identify the different roles played by living labs and their contributions to open innovation processes (Almirall & Wareham, 2008).

It is possible to obtain a greater knowledge of the project's origins, aims, and progress by analysing pertinent papers, as well as identify any obstacles or hurdles found throughout execution. Document analysis may also be used to confirm and triangulate the findings of interviews and observations, so improving the overall rigor and credibility of your research (Bowen, 2021). This thesis will study and analyse the project documents, reports, deliverables and grant agreements of related projects such as SPARCS and BaZe to investigate the methods were employed and expected results.

2.3.2 Data Analysis

The collected data will undergo a rigorous analysis process to derive meaningful insights and address the research question. The following steps will be undertaken:

Thematic analysis is a qualitative research approach that involves detecting, analysing, and reporting data patterns (themes). It entails meticulously arranging and characterizing the data collection, as well as analysing various facets of the study issue. Thematic analysis is a versatile method that may be tailored to various research problems and epistemologies. Thematic analysis is a flexible qualitative research approach that consists of many major components. Researchers become acquainted with the data, develop initial codes, look for themes, examine and improve those topics, define and label them, and eventually provide an analysis report (Braun & Clarke, 2006).

Before embarking on an analysis, it is important to consider several questions that can guide and inform the process. Firstly, the practical purpose of the analysis needs to be determined. This involves clarifying the intended use of the analysis, whether it is to find practical solutions, build theoretical frameworks, develop interventions, or evaluate a specific phenomenon. Understanding the practical purpose helps in setting the overall direction and focus of the analysis. Next, the analytic purpose should be defined by specifying the specific goals of the analysis. This involves determining whether the analysis aims to identify patterns, explore relationships, explain phenomena, compare different aspects, or confirm existing theories. Clearly articulating the analytic purpose enables researchers to align their methods and techniques with their intended goals. It is crucial to establish the connection between the analysis and the research questions. Researchers need to consider how the analysis will directly contribute to answering the research questions. Will the findings directly inform or provide insights into one or more of the research questions? Understanding this connection ensures that the analysis remains focused and relevant to the research objectives. Additionally, the timeline for the analysis should be taken into account. Researchers need to determine the timeframe available for completing the analysis. Is there a need for immediate turnaround, or is there more flexibility in terms of time? Considering the timeline helps in planning and organizing the analysis process effectively, ensuring that it can be completed within the allocated time frame (Guest et al., 2014).

Practical Purpose of the Case Study: The intended use of the analysis in the Maia case study is to evaluate the effectiveness and challenges of the implementation of living lab-driven technological solutions in an urban context. The analysis aims to provide insights into the practical aspects of the implementation process and identify areas for improvement in order to support the municipality's efforts for urban sustainability transition.

Analytic Purpose of the Case Study: The specific goals of the analysis in the Maia case study are to identify the factors that contribute to the effective implementation of living lab-driven technological solutions, explore the barriers and challenges encountered, and explain the dynamics and complexities of the implementation process. The analysis also aims to compare the experiences and outcomes of the Maia living lab with other relevant case studies to gain a broader understanding of the factors influencing successful implementation.

Connection to Research Questions: The analysis is directly connected to the research questions of the study. It will provide insights and answers to the research question of what factors

increase the effective implementation of living lab-driven technological solutions in an urban context and what are the most challenging barriers to achieving this goal. The analysis will directly inform and contribute to addressing these research questions by examining the data collected from interviews, observations, and document analysis.

Timeline of the Case Study: The timeframe for the analysis in the Maia case study started in 06.06.2022 and continued to 01.09.2023. Although the projects in Maia Municipality are ongoing and the final results and reports are not finalized yet.

Thematic analysis approaches will be used to analyse the literature, frameworks and interview data. Identifying and classifying reoccurring themes, patterns, and correlations in data is part of this process. Thematic analysis is a methodological technique that identifies, analyses, and report's themes or patterns in data (Saunders et al., 2023).

The Morgenstadt methodology is significant for the implementation of living labs for organizations because it provides a framework for developing and maintaining communities in urban environments (R. Katzy & Bücken, 2015). It explains how to build a living lab from the ground up, including the organizational and methodological components required to develop a research community comprised of engaged citizens and other stakeholders (Eriksson et al., 2016). The Morgenstadt methodology also stresses socio-technology as a guiding concept for defining and administering activities and services in living labs, notably for community formation and maintenance (Tellioğlu et al., 2019). Following this methodology allows organizations to harness the power of living laboratories to engage users and other stakeholders in the innovation process, resulting in the creation and deployment of long-term solutions that answer actual user requirements (Archibald et al., 2021). The Morgenstadt methodology will be employed to assess the capacity of the Maia Living Lab for urban sustainability transformation. This methodology involves defining the objectives and scope of the assessment, selecting relevant indicators, and collecting data to analyse the current state of Maia Living Lab's sustainability efforts as it was identified as the main methodology in SPARCS project as well. A gap analysis will be conducted to identify areas for improvement, followed by the development of high-priority measures to address these gaps by identifying relevant KPIs based on methodology as well as literature review.

Last but not least, comparative analysis allows for the assessment of organizational-level capacity will be facilitated through the document review and interview with the Light House City of SPARCS project, Leipzig to learn from their experience. It assists in explaining

unexpected variances between similar organizations as well as unexpected similarities across distinct organizations (Georges et al., n.d.). Comparative analysis allows for the resolution of perplexing outcomes at the organizational level by taking into account information located at higher or lower levels (Whetten, 2009). Comparative analysis may be used in the context of living labs to evaluate and analyse the practical structure and features of living lab research, offering a greater knowledge of the approach within a larger research process (Weld, 1988). By using comparative analysis, researchers can assess the nature of observations within living lab research and gain insights into the effectiveness and impact of living lab approaches in real-world environments of Maia district.

In conclusion, the research methodology employed in this study will culminate in a comprehensive gap analysis of the findings from the Maia Living Lab. This analysis will identify areas of strength and areas that require improvement within the living lab's implementation process. It will critically examine the barriers encountered, and the dynamics of the implementation process. The gap analysis will provide a clear understanding of the current state of Maia Living Lab's sustainability efforts and highlight the gaps that need to be addressed. Based on these findings, actionable recommendations will be proposed to enhance the effectiveness of the living lab and to support the municipality's efforts towards urban sustainability transition. These recommendations will be tailored to address the identified gaps and will provide a visual roadmap for future improvements. **Error! Reference source not found.** shows the general process and an overview of research design.

A roadmap serves as a strategic plan, delineating a goal and the essential steps to achieve it. This tool is vital in various contexts, including urban sustainability initiatives and living labs, since it provides clear objectives, aligning all activities towards these goals (Bryson & George, 2020).

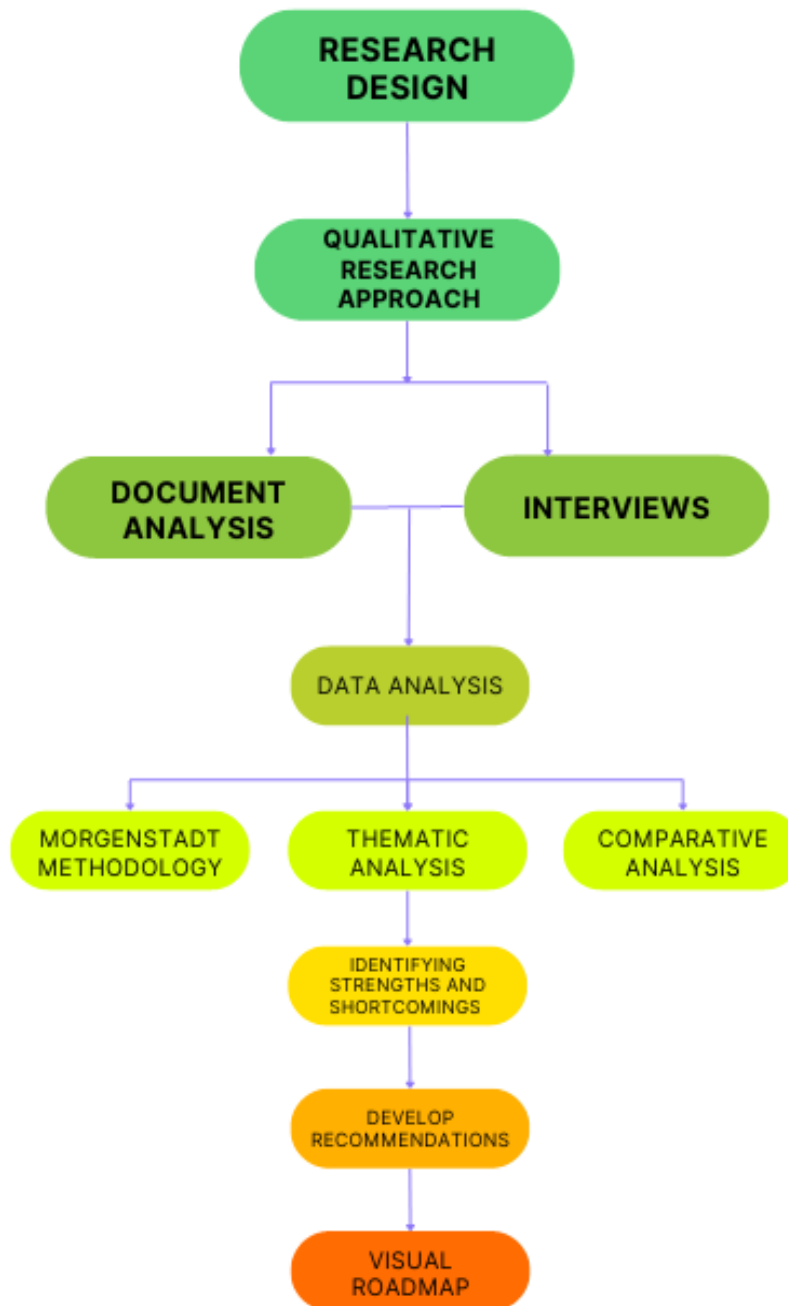


Figure 4: Overview of the Research Design

2.3.4 Delimitations, Limitations, Assumptions

This research has been precisely delimited to assess the efficacy and challenges in the implementation of living lab-driven technological solutions within the urban context of Maia. The focus has been on qualitative measures of success and barriers, gathered through interviews, document analysis, and the Morgenstadt methodology. By design, this study has not explored quantitative metrics of environmental impact or economic cost-benefit analyses of the implemented solutions. The temporal scope is also limited to the post-implementation phase of

the living lab projects, providing a snapshot rather than a longitudinal perspective of the sustainability initiatives.

The study faces several limitations that are inherent to the chosen research methodology and the context of the study:

- **Subjectivity in Qualitative Data:** Reliance on qualitative data from interviews may introduce subjectivity, as the data is based on personal experiences and perceptions of the stakeholders.
- **Selection Bias:** The selection of interviewees, primarily stakeholders directly involved with the living lab, may lead to a bias in the perspectives represented in the study.
- **Generalizability:** The findings, while in-depth regarding Maia's context, may not be fully generalizable to other urban contexts without further comparative analysis.
- **Access to Data:** Some relevant data may have been inaccessible due to confidentiality or logistical constraints, potentially limiting the comprehensiveness of the analysis.
- **Temporal Constraints:** The cross-sectional design of the study restricts the ability to capture the evolving dynamics of the living lab's impact over time.

Several assumptions underpin the methodological approach and interpretation of data in this research:

- **Stakeholders' Candor:** It is assumed that the stakeholders interviewed provided candid and accurate reflections of their experiences and perspectives.
- **Consistency in Reporting:** The study presumes that the documents analysed, such as project reports and policy documents, accurately represent the intentions and outcomes of the living lab initiatives.
- **Validity of Methodology:** The Morgenstadt framework is assumed to be an effective tool for assessing urban sustainability, and its application is presumed to provide valuable insights into the efficacy of living labs.
- **Stability of Context:** The research is predicated on the assumption that the political, economic, and social context of Maia remains relatively stable throughout the study period.
- **Transferability of Findings:** There is an underlying belief that the insights gained from this study will be valuable to similar urban sustainability initiatives and can contribute to broader discussions and practices within the field.

CHAPTER3: CASE STUDY, MAIA LIVING LAB

In this chapter, the focus is on the development of the case study analysis of Maia, a city dedicated to advancing urban sustainability through innovative projects. The chapter begins with a general introduction to Maia, providing insights into its population, geography, and economic characteristics that make it a relevant context for the study. The attention then shifts to two key initiatives driving sustainable development in Maia: The BaZe project and the SPARCS project. These projects embody Maia's vision for a sustainable future and serve as catalysts for transformative change. Through a thorough thematic analysis, the efforts, tasks, and outcomes related to the implementation of the Living Lab concept, sustainability transition, and organizational capacity building within the BaZe project are explored. The SPARCS project is also examined, incorporating the unique Morgenstadt methodology employed in Maia to foster urban sustainability. By conducting thematic analysis based on the categories that were introduced in previous chapter, the study will unfold the shortcomings and strength points of Maia regarding the Living Lab and its innovative solutions for a sustainable transition as well as a comparative analysis with the city of Leipzig, to gain valuable insights, similarities, and differences in approaches to urban sustainability. Moreover, key stakeholders from Maia municipality, project partners, and Leipzig Municipality are interviewed to gain first-hand perspectives and deepen the understanding of the case study context. By structuring the analysis in this manner, the aim is to answer the research questions, connect the findings to the existing literature, and contribute to the advancement of knowledge in the field of urban sustainability and transition.

3.1 The City of Maia

Maia, located in the north-western part of Portugal, had 134,977 residents in 2021, according to preliminary Census 2021 findings (INE, 2021). The city is divided into ten districts, as shown in Figure 5 (*Reorganização Administrativa Do Território Das Freguesias: Annex I. Law No. 11-A/2013, 2013*).

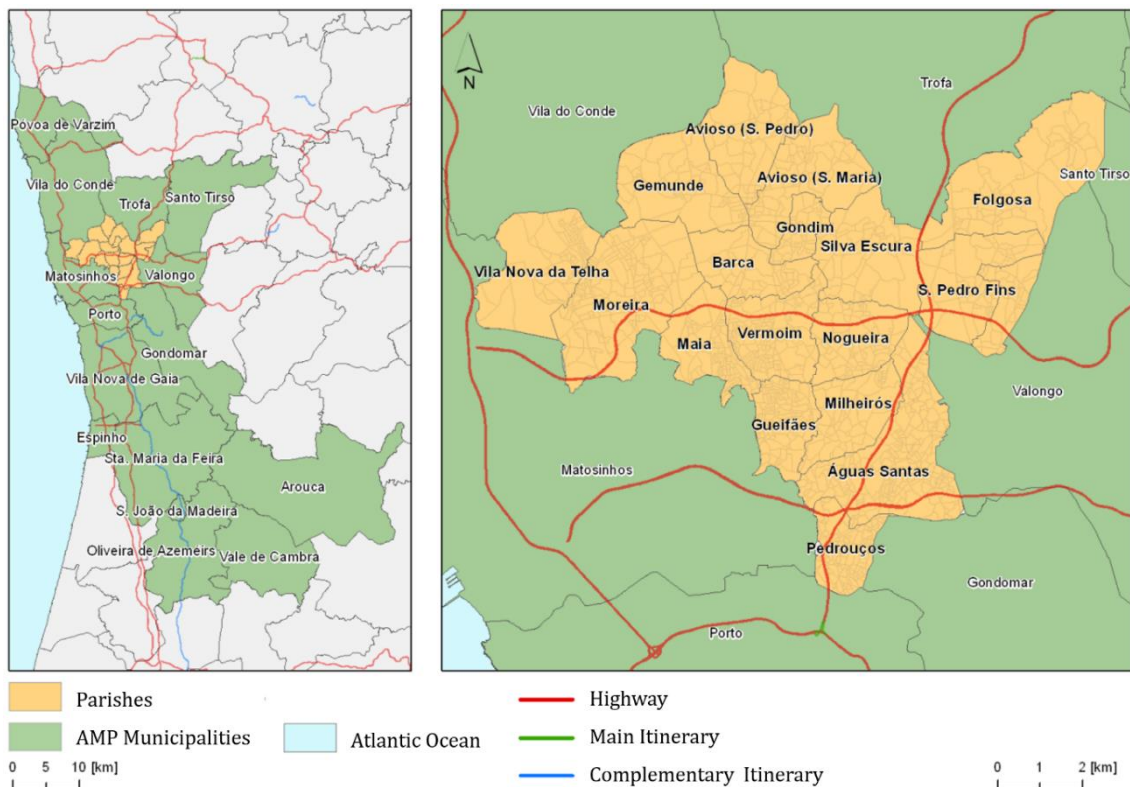


Figure 5: Map of the Region and the Administrative Division of Maia (Maia Municipality, 2021)

Maia is also one of Portugal's most industrialized towns that encompasses an area of about 82 square kilometres situated within the Greater Porto metropolitan area and is considered as a major transportation hub with a municipality that plays an important and influential role in industry, innovation, and new technology. Furthermore, the city exemplifies an urban settlement with economic and environmental growth, despite its low population density. Its geographical position provides easy access to major transportation routes, including highways and an international airport. Maia is characterized by a diverse landscape, featuring both urban and rural areas, with a rich natural heritage that includes green spaces, parks, and agricultural land (Maia Municipality, 2016).

The economy of Maia is dynamic and diverse, contributing significantly to the overall development of the region. The city is home to a range of industries, including manufacturing, services, commerce, and logistics. Maia's industrial sector is particularly noteworthy, with a concentration of businesses in areas such as textiles, electronics, automotive components, and food processing. This industrial activity has been a key driver of economic growth and employment opportunities in the city. Furthermore, Maia has also experienced a gradual shift

towards knowledge-based industries, with the emergence of technology parks and innovation hubs that foster entrepreneurship and research and development activities (INE, 2022).

What makes Maia particularly relevant for this study is its commitment to promoting urban sustainability and embracing innovative approaches to address environmental challenges. The city has undertaken various initiatives to transition towards a more sustainable future, focusing on areas such as energy efficiency, waste management, mobility, and community engagement. Notably, Maia is actively involved in the BaZe (Maia Living Lab - Net Zero Carbon City- **B**alanço **Z**ero de Carbono) and SPARCS (Sustainable energy **P**ositive & zero **cAR**bon **C**ommunitie**S**) projects, which aim to develop and implement sustainable solutions, test innovative technologies, and engage stakeholders in shaping the city's sustainable development. These projects reflect Maia's vision for a greener and more resilient city, making it an ideal case study for examining the implementation of urban sustainability strategies and the potential for replication in other contexts (Maia Municipality & AdEPorto, 2020).

3.2 The BaZe Project

The BaZe (Maia Living Lab - Net Zero Carbon City) project is a major effort launched by the Municipality of Maia, Portugal, with the goal of transforming the city into a model of urban sustainability. The project aims to promote the decarbonization of Maia's area via the implementation of new technical solutions that improve energy efficiency, cut consumption, and reduce environmental effect. BaZe acts as a reference location for these solutions' development, deployment, and testing, with the goal of analysing their scalability and potential for replication across the region.

The overall objectives of the BaZe project are multi-faceted. Firstly, the project strives to make Maia the first municipality in Portugal to achieve a carbon-neutral balance, positioning it as a pioneering Net Zero Carbon City. This ambitious goal aligns with the municipality's broader vision of sustainability, inclusivity, and resilience, aiming to improve the quality of life for its residents and communities. Secondly, BaZe aims to strengthen the association of Maia's image with innovation and sustainability by showcasing the city's commitment to adopting cutting-edge technologies and practices (Maia Municipality, 2018).

The BaZe initiative includes a variety of activities and interventions to attain its goals. These include deploying energy-efficient technology in public lighting systems, implementing smart energy management systems in buildings, promoting renewable energy micro-production

systems, and investigating circular economy practices. BaZe also entails the creation of a Living Lab named BaZe Oficina, which will function as an experiential workshop for encouraging cooperation, creativity, and community empowerment. The BaZe project intends to drive the transition to a low-carbon and sustainable urban environment through these different activities, while actively engaging the municipality's workforce and the broader community in the project's execution and dissemination.

Furthermore, the BaZe - Living Lab incorporates various actions addressing energy efficiency in buildings, renewable energy production, public charging hubs for electric vehicles, smart parking, vehicle traffic counting systems, air quality, green roofs, Pay-As-You-Throw solutions, and water irrigation management systems, among others. The municipality is also gathering data from sensors and other sources in order to test its urban data platform, which integrates various types of data and sources in order to inform and support stakeholders, citizens, and other target audiences (Maia Municipality, 2020).

3.3 The SPARCS Project

The SPARCS (Sustainable energy Positive & zero cARbon Communities) project is an innovative initiative aiming to transform cities into sustainable and inclusive urban environments. SPARCS seeks to catalyse urban transformation while maintaining a high quality of life for citizens in the seven project cities. The project's primary focus is to foster digitalization, sustainable energy, improved air quality, electro-mobility solutions, and a performance monitoring framework for the developed solutions, all under the umbrella of a shared bold City Vision 2050. Crucially, the project emphasizes the integration of management and planning models, along with participatory processes involving various stakeholders such as companies, urban ecosystem experts, urban planners, research institutions, and citizens. Citizens are at the core of the decision-making process, ensuring that they are well-informed about all activities.

The city of Maia aspires to become a smart, sustainable, inclusive, and carbon-neutral community. Recognizing the potential support and acceleration offered by the SPARCS project, Maia is determined to achieve Positive Energy & Zero Carbon status by 2050. Maia has begun crafting a City Vision for 2050 in five strategic areas critical to carbon neutrality and energy transition: Urban Development, Energy Transition, Mobility, Smart and Sustainable City, and Inclusive and Integrated City. As a Fellow City, Maia has worked on its replication strategy,

engaging in comprehensive discussions during the onsite assessment to explore forward-thinking solutions related to each strategic area. These co-creative sessions have facilitated the identification of projects that can be implemented, ensuring a strong collaboration between the city and all stakeholders, thus contributing significantly to the forthcoming activities for the Maia Replication Strategy (*D5.4: Implementation Plan Maia, 2022*).

3.3.1 The Morgenstadt Framework in SPARCS project

The SPARCS project's assessment framework allows for the evaluation of cities' sustainability performance. This framework is divided into two levels of analysis: indicator evaluation and action field evaluation. The indicator evaluation focuses on determining the present state of urban systems, notably in the energy sector. A collection of 62 carefully chosen indicators is used to assess several factors such as mobility, society, economics, information and communication technology, and the environment. The evaluation of action fields, on the other hand, assesses how cities handle sustainability and determines priority areas and significant actions. To identify municipal concerns and assess the creation and execution of relevant initiatives, 35 action categories with 118 'yes/no' type questions are designed.

The framework includes ICT, governance, transportation & mobility, energy, and building change. The examination looks at ICT applications in traffic management and participatory governance, which allow cities to adjust to changing conditions and make informed decisions based on past data. Municipal strategy and planning, organization and structure, and rules and incentives are all assessed in governance-related action categories. These fields reveal information on a city's long-term vision, political stability, and policy management. The transportation and mobility evaluation focuses on soft mobility infrastructure, intramodality, e-mobility prioritization, and urban freight optimization. Municipal energy generation, renewable sources, district heating, and citizen involvement in efficient consumption and distributed energy generation are all evaluated in energy-related action domains. Finally, building transformation evaluation looks at building performance, restoration, and construction. Cities may acquire a complete knowledge of their sustainability profile, identify issues and possibilities, and establish cohesive plans by using this evaluation approach. External elements such as socio-cultural dynamics, geography, and historical context are all taken into account by the framework. Throughout the evaluation process, standardized data assessment helps the identification of essential areas for improvement and aids in the formulation of project outlines and roadmaps.

Maia is seeking for additional support in creating solutions for sustainable energy usage. Fraunhofer IAO, through its Morgenstadt Initiative and in strategic collaboration with the municipality of Maia, co-designed a project to assist the city in the development of a list of project ideas for transformation and support of the city's development ambitions. The purpose of this City Lab is to assist the city in becoming a role model in Portugal for an energy efficient city on its road to being a zero-carbon community, with better mobility and quality of life. The initiative was brought to fruition through a collaborative effort between the Municipal Council of Maia, the Portuguese Society of Innovation Consultancy S.A., AdEPorto - Porto Energy Agency, and Centre (SPARCS, 2022).

The Morgenstadt assessment framework for sustainable urban development serves as the foundation for Maia's in-depth examination. The model was created as part of the "Morgenstadt: City Insights" collaborative research project, in which 10 Fraunhofer Research Institutes collaborated with 37 other partners from municipal governments and industry to provide cities with comprehensive assistance for sustainable city development. The project began in 2012, and the approaches have been continuously adapted and refined since then (Fraunhofer IAO, 2022).

In order to achieve an in-depth understanding of the sustainability performance of cities both qualitatively and quantitatively, the Morgenstadt Model is structured into three levels of analysis:

1. Key performance indicators (quantitative analysis)
2. Action fields (qualitative analysis)
3. Impact factors (qualitative analysis)

The examination of this data reveals a Maia status quo inventory and answers the question, "What is the city's sustainability performance?" Furthermore, it evaluates the types of data being monitored and available at the municipal level in order to offer a comprehensive knowledge of the city's sustainability in the energy sector and other relevant areas. This shared understanding of the city's difficulties, plans, and possibilities serves as the foundation for the co-creation and design activities outlined below.

The third level of analysis utilizes impact variables to identify city-specific drivers and obstacles based on distinctive historic, cultural, economic, climatic, and physical aspects.

Impact factors thereby expand and adapt the basic model to the demands of each city, offering an objective performance profile while establishing the groundwork for a specific sustainability roadmap. The process in the setting of City Lab is divided into four main steps, as illustrated in Figure 6 (*D5.4: Implementation Plan Maia, 2022*).

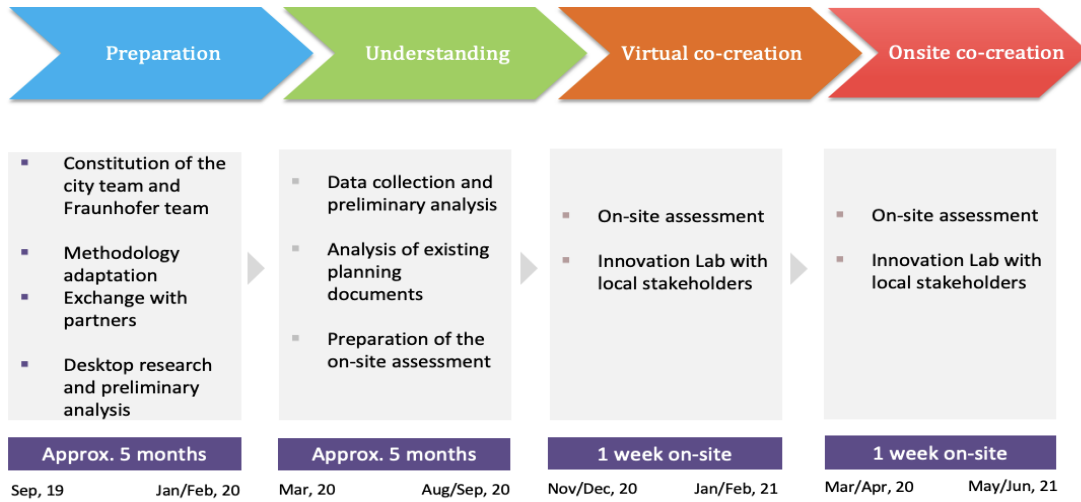


Figure 6: Structure of the Morgenstadt process in Maia.

The combination of all evaluation levels allows the research team to gather information of the city's baseline sustainability profile, which is the city's current performance in energy and closely connected critical areas, assisting in the design of coherent strategies. The technique considers the city's impact factors, which are influenced by external influences, socio-cultural dynamics, geography, and historical pre-determinations, among other things. Furthermore, consistent data assessment throughout the evaluation process assists in the identification of important difficulties and prospects for the construction of project outlines and the roadmap. Figure 7 depicts the evaluation process (*D5.4: Implementation Plan Maia, 2022*):

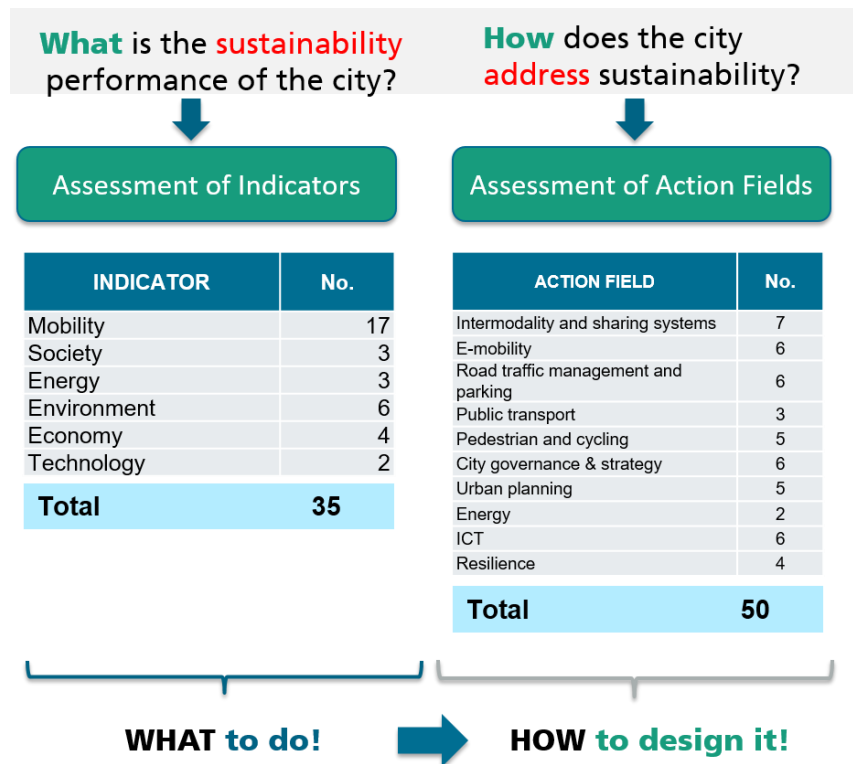


Figure 7: Morgenstadt assessment framework for Maia

3.4 Lighthouse City of Leipzig and Replicability

Leipzig is one of the SPARCS project's Lighthouse Cities, which means it has already adopted innovative solutions to become more sustainable and energy efficient. Leipzig has taken various steps, including the creation of a smart grid, the installation of solar panels, and the construction of energy-efficient buildings. These initiatives have assisted Leipzig in decreasing its carbon footprint and becoming a more sustainable city. Maia may learn from Leipzig's experience and apply some of the initiatives done in Leipzig to become more sustainable. The SPARCS initiative intends to encourage knowledge transfer and replication of best practices between Lighthouse Cities and Follower Cities, and Maia will benefit from this information exchange to become a more sustainable city (SPARCS, 2022).

3.5 Thematic analysis

In the process of conducting the thematic analysis for this research, the categories and sub-categories developed in Chapter 1 will be utilized as initial thematic codes. These categories and sub-categories, derived from a comprehensive review of the literature and a deep understanding of the subject matter, provide a robust framework for interpreting the data. They

will serve as a guide to identify and code recurring patterns and themes in the data. However, while these established categories will provide a valuable starting point, the coding process will remain flexible and iterative. This approach will allow for the emergence of new themes or adjustments to existing ones as necessary, based on the actual data. This balance between a structured approach and openness to the data will ensure a comprehensive and nuanced understanding of the themes that emerge from the analysis. Table 3 explains how the criteria and sub-criteria developed in previous chapter were addressed within BaZe and SPARCS projects.

Table 3: Thematic analysis of criteria and sub-criteria to evaluate Maia Living Lab (D5.4: Implementation Plan Maia, 2022 and Maia Municipality, 2018)

Criteria	Sub-criteria
<p>Co-creation and Collaboration</p>	<p>Both the SPARCS and BaZe projects in Maia have demonstrated a commitment to co-creation and collaboration. This is evident in the implementation of the City Lab co-creative methodology in the SPARCS project, which facilitated dialogue and the identification of projects for implementation. Similarly, the BaZe project included a work package focused on Sensitization and Social Participation, with an operation called "Co-creation" aimed at involving the population in the adoption of new technologies and systems.</p> <p>Stakeholder Engagement: In both projects, Maia has engaged with various stakeholders, including public and private institutions and entities. In the SPARCS project, around 18 members of the civil society were present in a co-creation workshop. In the BaZe project, the plan was to create a community movement called "MeT - Maia in Transition" to catalyse the adoption of new technological solutions and social organization.</p> <p>Citizen Involvement: The SPARCS project report mentions the importance of citizen engagement and training in project implementation and implements several activities with citizens included. The city vision activity demonstrates Maia's commitment to involving and sensitizing participants on the importance of combating climate change. By discussing ideas, presenting solutions, and envisioning a sustainable and economically balanced city for the next 30 years. The workshops on the roadmap for urban transformation further emphasize Maia's efforts in co-creation and collaboration. These workshops bring together city departments, research and university representatives, metropolitan agencies, citizen representatives, for-profit organizations, societal organizations, NGOs, and other</p>

Criteria	Sub-criteria
	<p>stakeholders. By involving these diverse groups, Maia fosters collaboration and the exchange of knowledge, ideas, and expertise in developing a roadmap for urban transformation. This inclusive approach ensures that multiple perspectives are considered, enabling effective co-creation and collaboration among stakeholders (T1.6, SPARCS). The BaZe project aimed to involve the population in the adoption of new technologies and systems through the "Co-creation" operation.</p> <p>Challenges and Adaptations: Despite the emphasis on co-creation and collaboration, there have been challenges in executing these activities. In the BaZe project, the Co-creation action had to be cancelled due to the delayed initiation of other actions. However, the project team is considering restarting the Co-creation action in the context of the MiT project.</p>
Real-world setting	<p>Description: Both the SPARCS and BaZe projects in Maia have established Living Labs in real-world settings. These Living Labs, namely the Maia Living Lab Central Area and BaZe - Living Lab, are situated within the city of Maia and serve as practical environments for implementing and testing innovative solutions to address energy and sustainability challenges.</p> <p>Innovative Solutions: The Living Labs in Maia are focused on implementing a variety of innovative solutions. These include energy efficiency in buildings, renewable energy source (RES) production, public charging hubs for electric vehicles, smart parking, vehicle traffic counting systems, air quality monitoring, green roofs, Pay-As-You-Throw solutions, and water irrigation management systems. These solutions are designed to address a range of sustainability challenges in a practical, real-world context.</p>
Experimentation and learning	<p>Description: Both the SPARCS and BaZe projects in Maia have established Living Labs as spaces for experimentation. These Living Labs serve as testing grounds for a variety of innovative solutions addressing energy efficiency, renewable energy production, sustainable mobility, and more. The solutions are tested and evaluated in real-world settings, providing valuable insights into their effectiveness and potential for scalability. The Living Labs in Maia are also platforms for learning. The SPARCS project, for instance, is collecting data from sensors and other sources to inform and support stakeholders, citizens, and other target audiences. The BaZe project, on the other hand, has designed a series of workshops and training sessions aimed at building capacity among stakeholders and promoting the adoption of new technologies and practices. These initiatives indicate a strong commitment to knowledge sharing and capacity building.</p>

Criteria	Sub-criteria
	<p>Data Collection and Standards: The Living Labs in Maia are engaged in data collection activities, with the municipality collecting data from sensors and other sources to test its urban data platform. Additionally, Maia is working on implementing the international standard ISO 37120 - Sustainable development of communities, indicating a commitment to recognized sustainability standards</p> <p>Interactive and Participatory Approach: The BaZe project, in particular, emphasizes an interactive and participatory approach to learning. The workshops and training sessions are designed to be interactive and participatory, with a focus on co-creation and collaboration. This approach not only facilitates learning but also fosters engagement and ownership among stakeholders.</p>
Flexibility and adaptability	<p>Flexibility in Testing Solutions: The Living Labs in Maia are described as spaces for experimentation and learning, where different solutions addressing energy efficiency, renewable energy production, and various sustainability challenges are tested and evaluated. This indicates a flexible approach to testing and validating solutions, allowing for the exploration of diverse options.</p> <p>Adaptability to Changing Circumstances: The Living Labs in Maia are designed to be flexible and adaptable to changing circumstances. The report mentions that the Living Labs are focused on monitoring, assessment, and scalability analysis, indicating a willingness to assess and adjust the initiatives based on the feedback received. Additionally, revisiting financial models and identifying adequate resources for scalability suggests a commitment to adapting to changing financial circumstances.</p> <p>Tailoring Solutions to Real Needs: The Living Labs in Maia emphasize co-creation and collaboration with stakeholders to identify real needs and develop solutions tailored to those needs. This approach ensures that the initiatives implemented are relevant and responsive to the specific challenges faced by the city.</p> <p>Standardization and Scaling: The BaZe project specifically mentions the intention to validate and develop solutions that can be adapted and standardized for use in other contexts. This highlights the goal of scalability and the potential for transferring successful interventions to other cities or regions.</p>
Long-term perspective	<p>Strategic Alignment: The Living Labs in Maia are designed with a long-term perspective, aligning with the broader strategic plan of "BaZe - Building a Zero</p>

Criteria	Sub-criteria
	<p>Emissions Maia." This strategic plan sets a clear target for the city to achieve carbon neutrality by 2050, emphasizing the long-term vision of the Living Labs in addressing energy and sustainability challenges in SPARCS project as well.</p> <p>Evaluation and Monitoring: The Living Labs in Maia place importance on monitoring, assessment, and scalability analysis, suggesting a commitment to evaluating the long-term impacts of the implemented solutions. This evaluation process allows for continuous learning, identifying successful interventions, and informing future decision-making.</p> <p>Financial Sustainability: The report highlights the Living Labs' focus on revisiting financial models and identifying adequate resources for scalability, indicating a consideration for long-term financial sustainability. This aspect is crucial for ensuring the continuity and viability of the Living Labs' initiatives beyond the initial phases.</p>
<p>Integration of social, environmental, and economic aspects</p>	<p>Social Integration: The Living Labs in Maia promote social engagement through various tools and activities such as events, fairs, games, art, sports, and training activities. These activities aim to involve and engage citizens, fostering their participation and awareness in energy and sustainability initiatives. By incorporating social engagement tools, the Living Labs encourage community involvement and support for sustainable practices.</p> <p>Environmental Integration: The Living Labs in Maia are designed to address various environmental challenges through the integration of different actions. These actions include energy efficiency in buildings, RES production, public charging infrastructure for electric vehicles, smart parking, vehicle traffic counting systems, air quality monitoring, green roofs, Pay-As-You-Throw solutions, and water irrigation management systems. By focusing on these areas, the Living Labs aim to contribute to environmental sustainability, resource conservation, and the promotion of circular economy principles.</p> <p>Economic Integration: The Living Labs in Maia consider the economic perspective by revisiting financial models and identifying adequate resources for scalability. This demonstrates a commitment to ensuring the economic sustainability of the initiatives. Additionally, the interaction between the municipality, knowledge centres, companies, industries, and citizens promote the circular economy. This integration of stakeholders and resources fosters economic collaboration and supports sustainable economic growth within the city.</p>

Criteria	Sub-criteria
Citizens	<p>Citizens: The Living Labs in Maia actively involve citizens in the co-creation process. Citizens are seen as the central piece of the project, and their participation and engagement are essential. The Living Labs provide a space for citizens to participate in prototyping and small-scale experiments, engagement, and scaling good practices across the territory. This involvement allows citizens to contribute to the development and testing of solutions that address energy and sustainability challenges in the city.</p>
Local governments and public authorities	<p>Local governments and public authorities: Local governments and public authorities play a crucial role in the Living Labs as they are part of the strategic planning and implementation process. The Living Labs are integrated into the broader initiative of achieving carbon neutrality in Maia by 2050. Collaborating with local governments and public authorities ensures that the solutions developed in the Living Labs align with the city's goals and policies, facilitating their adoption and scalability.</p>
Private sector and businesses	<p>Private sector and businesses: The Living Labs attract interest and involvement from the private sector and businesses. These entities bring their solutions, tools, and expertise to the Living Labs. Collaborating with the private sector and businesses fosters innovation, entrepreneurship, and the development of market-ready solutions. It allows for the identification of real needs and the development of solutions that can be adapted and scaled up beyond the Living Labs.</p>
Researchers and academic institutions	<p>Researchers and academic institutions: Researchers and academic institutions have a significant role in the Living Labs, particularly in monitoring, impact assessment, and policy development. Their involvement ensures that the solutions implemented are backed by research and evaluated for their effectiveness. Researchers and academic institutions also contribute to the development of policies that support open access to urban data, fostering transparency and knowledge sharing.</p>
Non-governmental organizations	<p>Non-governmental organizations: Non-governmental organizations (NGOs) participate in the Living Labs, contributing their expertise and perspectives. Their involvement ensures a multi-stakeholder approach and brings in diverse viewpoints. NGOs can represent specific interest groups, advocate for sustainable practices, and facilitate community engagement and participation in the Living Labs.</p>

Criteria	Sub-criteria
Technology providers and startups	<p>Technology providers and startups: Technology providers and startups are valuable participants in the Living Labs. Their involvement brings innovative solutions and tools that can be tested and validated in a real-world setting. Collaborating with technology providers and startups promotes innovation and supports the development of cutting-edge technologies that address energy and sustainability challenges.</p>
Urban planners and designers	<p>Urban planners and designers: Urban planners and designers play a role in defining the locations of parks and implementing smart irrigation solutions within the Living Labs. Their expertise in spatial planning and design contributes to the sustainable development of urban areas. By incorporating their input, the Living Labs can enhance the efficiency and effectiveness of urban infrastructure and green spaces.</p>
Financial institutions and investors	<p>Financial institutions and investors: Financial institutions and investors have a role in identifying adequate resources for scalability. Their involvement ensures the financial sustainability of the Living Labs and supports the implementation of solutions beyond the experimental phase. Exploring different funding options allows for the long-term viability of the initiatives.</p>
International organizations and networks	<p>International organizations and networks: International organizations and networks contribute to the Living Labs by promoting knowledge exchange and collaboration. Their involvement facilitates the sharing of best practices, lessons learned, and global trends in energy and sustainability. Collaborating with international organizations and networks expands the reach and impact of the Living Labs beyond the local context.</p>
Purpose: Strategy development through action	<p>The Living Lab in Maia serves as a space for experimentation and learning, where different solutions addressing energy efficiency, renewable energy production, sustainable mobility, waste management, air quality, and other areas are tested and evaluated. The primary purpose of the Living Labs is to develop a strategy for addressing energy and sustainability challenges in the city through real-world action and implementation.</p> <p>It integrates various actions and initiatives that aim to tackle these challenges. By testing and evaluating different solutions, the Living Labs enable the identification of best practices, lessons learned, and scalable interventions. The focus on monitoring, assessment, and scalability analysis suggests a strategic approach to the</p>

Criteria	Sub-criteria
	<p>development of solutions, ensuring that successful interventions can be expanded and replicated in other contexts.</p> <p>Furthermore, the Living Lab in Maia emphasizes the integration of social, environmental, and economic aspects. The circular economy is promoted through interactions among the municipality, knowledge centres, companies, industries, and citizens. This integrated approach ensures that strategies developed through the Living Lab considers the social well-being, environmental sustainability, and economic viability of the city.</p> <p>The Living Lab also promotes social engagement through events, fairs, games, art, sports, and training activities. This fosters citizen participation and involvement in the development and implementation of strategies. By engaging citizens and local agents in prototyping, small-scale experiments, and scaling good practices, the Living Lab encourages collective action and ownership of the solutions.</p>
<p>Organization: Network forms around a region (regional development) or a funded project (e.g., public funding)</p>	<p>The Maia Living Labs are intended to foster cooperation and participation among these many groups. This means that the Living Labs are organized around the formation of a network of stakeholders from all backgrounds, all working together to address the city's energy and environmental concerns. The Living Labs are experimental and learning spaces where diverse ideas are tested and assessed, enabling communal action and information exchange among participants.</p> <p>This strategic plan for the city of Maia aims to achieve carbon neutrality by 2050, and the Living Lab is a key component of this plan. National and EU level funding agencies are resourcing these initiatives.</p>
<p>Action: Information is collected and used together and knowledge is co-created in the network</p>	<p>The BaZe project document emphasizes that the Living Lab is intended to be a space for experimentation and learning, where stakeholders from various sectors, including local governments, businesses, researchers, non-governmental organizations, technology providers, urban planners, financial institutions, and international organizations, work together to build capacity, promote the adoption of new technologies and practices, and achieve carbon neutrality in the city of Maia by 2050. The project team focuses on co-creation and collaboration with stakeholders, aiming to identify real needs, develop scalable solutions, and standardize practices for use in other contexts. This indicates a strong emphasis on information sharing, knowledge co-creation, and the collective utilization of data and insights generated within the network.</p>

Criteria	Sub-criteria	
	<p>Similarly, the SPARCS project report highlights the role of knowledge co-creation and information sharing in the Living Labs in Maia. It mentions the involvement of various stakeholders, including citizens, local governments, businesses, researchers, non-governmental organizations, technology providers, urban planners, financial institutions, and international organizations. The report emphasizes the collaborative nature of the Living Labs, promoting engagement and collaboration among these different groups to address energy and sustainability challenges in the city. The involvement of researchers and academic institutions in monitoring and impact assessment, citizen participation in prototyping and small-scale experiments, technology providers and startups in developing and testing new solutions, urban planners and designers in defining locations and implementing smart solutions, financial institutions and investors in identifying resources, and international organizations and networks in promoting knowledge exchange and collaboration are foreseen.</p> <p>Both the BaZe project and the SPARCS report suggest that the Living Lab in Maia is designed to facilitate the collection and use of information together and foster the co-creation of knowledge within the network. The emphasis on collaboration, engagement, and the involvement of various stakeholders indicates a commitment to shared learning, data-driven decision-making, and the development of open and accessible policies and solutions.</p>	
<p>Outcomes: Guided strategy change into a preferred direction</p>	<p>The focus of Maia is primarily on developing strategies through action, testing and evaluating different solutions, and promoting collaboration and engagement among various stakeholders specifically by following the Roadmap for City Vision 2050 developed under WP1 in SPARCS project.</p>	
<p>Lifespan: Short/medium/long</p>	<p>Both the BaZe project and the SPARCS project indicate that the Living Lab in Maia is intended to be a long-term initiative that extends beyond the duration of the current projects. The Living Lab is designed to be flexible and adaptable, allowing it to evolve over time to meet changing needs and incorporate new ideas and technologies. This suggests that the Maia Living Lab is not a short-term endeavour but rather an ongoing and sustained effort.</p>	
<p>Planning phase</p>	<p>deep understanding of the underlying circumstances of the project and mix</p>	<p>the planning phase of the Living Lab in Maia involved the constitution of a local team and the assessment team from Fraunhofer, indicating a collaborative approach. The Living Lab aims to promote collaboration and</p>

Criteria	Sub-criteria	
	different competencies to stimulate knowledge sharing and an increased understanding of the involved stakeholders' visions	engagement among different stakeholders, including citizens, local governments, businesses, knowledge centres, and industries. By involving various stakeholders, the project aims to mix different competencies and stimulate knowledge sharing, leading to an increased understanding of stakeholders' visions and a deep understanding of the project's underlying circumstances. Therefore, the planning phase appears to align with this criterion.
	Influencing the innovation process by users	The emphasis on co-creation and collaboration with stakeholders, including citizens, suggests that there is potential for users to participate in the innovation process by providing feedback, insights, and ideas
	designed to capture as realistic a situation as possible	The SPARCS project the integration of various actions addressing energy efficiency, renewable energy production, smart infrastructure, and environmental services suggests that the Living Lab aims to capture realistic situations and challenges faced by the city of Maia. By implementing real-world solutions and engaging multiple stakeholders, the Living Lab endeavours to create a context that reflects the complexities of the urban environment.
	Building organizational capacity in planning phase	The constituting a local team and the emphasis on collaboration with stakeholders suggests that there is an intention to involve and strengthen organizational capacities of the participating entities.
	Openness	The project documents highlight the involvement of various stakeholders, including citizens, local governments, businesses, knowledge centres, and international organizations. The intention to develop policies and solutions that are open and accessible to all suggests an openness in the approach of the Maia Living Lab.

Criteria	Sub-criteria	
	Value creation	Both the SPARCS project and the BaZe project emphasize the integration of social, environmental, and economic aspects in the Maia Living Lab. The focus on testing and validating solutions, identifying best practices, and scaling up successful interventions indicates a goal of value creation. The projects aim to achieve carbon neutrality, promote sustainable practices, and address energy and sustainability challenges in the city of Maia.
Prototype Design	Identifying stakeholders' needs	Both the BaZe project and the SPARCS project emphasize the involvement of various stakeholders, including local governments, public authorities, private sector and businesses, researchers and academic institutions, non-governmental organizations, technology providers and startups, urban planners and designers, financial institutions and investors, and international organizations and networks.
	The design of the innovation broadens to include basic functions, workflows, and interfaces	Both the BaZe project and the SPARCS project emphasize on testing and validating solutions that can be adapted and standardized for use in other contexts suggests that the design of the innovation will encompass various functions, workflows, and interfaces.
	evaluation is focused on interaction between the user and the service	The information from both projects suggests that the participatory nature of the Living Lab and the focus on prototyping, small-scale experiments, and engagement indicate an intention to evaluate and improve the user experience and the interaction between users and the implemented services.
Sustainability Transition	Energetic refurbishment in buildings	The SPARCS project report suggests that there are projects in Maia that focus on energetic refurbishment in buildings, such as the installation of energy-efficient equipment, renewable energy sources like photovoltaic panels, LED lighting in public spaces, and the implementation of smart technologies like motion

Criteria	Sub-criteria
	<p>sensors. These initiatives aim to improve energy efficiency, reduce energy consumption, and promote the use of renewable energy in buildings.</p> <p>The report also highlights the importance of holistic promotion of renewable energy use in Maia. It suggests that investors can be motivated to install or use renewable energies in new buildings or during renovation projects, offering strategic pilot projects as examples. This indicates an intention to drive the transition towards sustainable energy solutions in buildings.</p> <p>However, the report mentions that the current rate of refurbishment in Maia, indicated by the annual rate of refurbishment as a percentage of existing building stock, is only 0.11%, which falls below the target value of 5%. This suggests that there is room for improvement and an opportunity to increase the pace of building refurbishments in Maia.</p>
	<p>District Management - small-scale use-mix in local districts</p> <p>The activities of the Maia Living Lab in energy efficiency, renewable energy, and circular economy integration can indirectly contribute to the sustainability transition in local districts. This could involve working closely with local governments, urban planners, businesses, and communities to develop and implement sustainable strategies, resource management practices, and urban design approaches at the district level.</p>
	<p>Creation of an atmosphere open to innovation and transformation regarding sustainability,</p> <p>Both the SPARCS report and the BaZe document suggest that the Maia Living Lab is designed to create an atmosphere open to innovation and transformation regarding sustainability.</p>
	<p>Promotion of renewable energies, Activation of business</p> <p>Both sources indicate that Maia promotes renewable energies and actively engages business actors to support the sustainability strategy of the city. The BaZe document</p>

Criteria	Sub-criteria
	<p>actors for supporting the sustainability strategy of the city</p> <p>mentions projects such as the "BaZe-Oficina" project, which involves the requalification of a building as a Smart Lab and incorporates energy-efficient equipment and renewable energy sources like photovoltaic panels. This project serves as a model for other buildings, contributing to Maia's goal of achieving carbon neutrality by 2050. Additionally, the installation of LED lighting and motion sensors in public spaces is highlighted as energy-saving measures.</p> <p>The SPARCS report reinforces the promotion of renewable energies in Maia, stating that the municipality participates in the "Porto Solar Metropolitano" project, which installs photovoltaic panels on municipal buildings for electricity self-consumption. This initiative significantly increases the contribution of renewable energy for municipal use. The report also emphasizes the need to create favourable conditions for renewable energy use and energy efficiency policy development in Maia.</p>
	<p>Development and implementation of services for supporting sustainability solutions.</p> <p>The SPARCS report highlights that Maia develops and implements services for supporting sustainability solutions through its Living Lab. The Living Lab integrates various actions addressing energy efficiency in buildings, renewable energy production, sustainable mobility solutions (such as public charging hubs for electric vehicles and smart parking), environmental monitoring systems (such as vehicle traffic counting and air quality), green infrastructure (including green roofs), waste management (such as Pay-As-You-Throw solutions), and water irrigation management systems, among others. These initiatives demonstrate the city's commitment to testing and evaluating different solutions to address energy and sustainability challenges.</p>
	<p>Community energy management</p> <p>The combination of energy-efficient measures, renewable energy installations, and the overall focus on sustainability in the Maia Living Lab suggests a commitment to energy management at the community</p>

Criteria	Sub-criteria	
		level. The Living Lab's integration of various actions, including energy efficiency in buildings and renewable energy production, indicates a comprehensive approach to energy management and sustainability.
	Creation of markets for sustainable products & solutions,	The collaborative nature of the Living Lab and the involvement of stakeholders, including the private sector and businesses, suggest a potential for market development in the sustainable solutions space.
	Awareness/Education: Creating awareness of sustainability through the integration of sustainability issues in education and information	The SPARCS report suggests that Maia promotes sustainability awareness through the integration of sustainability issues in education and information. The report mentions the Plan on Environmental Education (PEA), which aims to strengthen the integration of science and technology by encouraging sustainable practices and minimizing society's negative impacts on the environment. The report also highlights that Maia has developed indicators to monitor the progress of sustainability goals, including indicators related to education and awareness-raising activities.
Organizational Capacity Building	Establishment of sustainability advisory boards	The involvement of stakeholders from different sectors suggests a potential for organizational capacity building efforts.
	Creation and administration of platforms for citizen participation.	According to the BaZe project, Maia creates and administers platforms for citizen participation. The implementation of the Plataforma FOCUSBC is mentioned as an interactive and integrative platform that aims to involve the public in the appropriation of technologies and promote their participation in the process. This platform provides information to the public, such as air quality data, and facilitates data analysis and information sharing with the community.

Criteria	Sub-criteria	
	Training of administrative staff in sustainability issues	<p>SPARCS Project: Maia has conducted training activities for various stakeholders, including municipality staff, private owners, companies, energy providers, transport operators, public interest entities, citizens, and local community-based associations/groups. These training activities aim to enhance health literacy, mobilization for the maintenance of the neighbourhood, and community engagement. By providing training to administrative staff and other stakeholders, Maia demonstrates a commitment to building capacity and knowledge in sustainability issues.</p> <p>BaZe Project: The BaZe project also includes training activities related to sustainability. The training activities mentioned involve the GCMC marketing and citizenship communication office, tourism unit, technicians for drone usage, and permaculture training. These activities aim to enhance knowledge and skills in sustainable practices, waste management, and permaculture.</p>

Two sub-categories of Creation of flat hierarchies within city administration and Creation of administrative structures for communal sustainability management are not assessed in Table 3 because of absence of any information/ plans to address these topics. Therefore, they have been identified as the gaps to be considered while developing the recommendations.

3.6 Comparative Analysis

To assess the organizational capacity building efforts for sustainable urban transformation in urban living labs in the light house city (Leipzig) and the fellow city (Maia), I summarised the criteria presented in the Analytic Framework into seven macro-categories. Firstly, the policy and governance framework should be evaluated to understand the institutional arrangements and regulatory mechanisms in place. Stakeholder engagement and collaboration should be assessed to determine the level of involvement of various actors in decision-making processes (Gasco-Hernandez et al., 2022; UNEP, 2015). Institutional capacity and leadership, including the presence of dedicated departments or agencies, are important for driving sustainable urban

transformation. Planning and integration efforts, such as urban development plans and land-use policies, should be examined (Global Commission Economic Advisory Panel et al., 2014). The availability of financing mechanisms to support sustainability initiatives is another key criterion. Knowledge sharing and capacity building activities, including training programs and partnerships, should be evaluated (Gasco-Hernandez et al., 2022; UNEP, 2015). Data collection and monitoring systems are crucial for evidence-based decision making. Social equity and inclusion considerations should be analysed to ensure that sustainable urban transformation benefits all segments of society. Innovation and technology adoption should be assessed to determine the utilization of new solutions and approaches. Lastly, replicability and scalability potential should be considered to assess the transferability of successful practices to other contexts (Global Commission Economic Advisory Panel et al., 2014).

Table 4: Comparative Analysis of Maia and Leipzig

Criteria 1: Policy and Governance Framework Assessment of the comprehensiveness, coherence, and effectiveness of policies, regulations, and institutional arrangements in driving sustainable development.	
Leipzig	<p>New Leipzig Charter: The New Leipzig Charter is a key policy framework document for sustainable urban development in Europe. It emphasizes the need for cities to establish integrated and sustainable urban development strategies and ensure their implementation. This charter encourages cities to focus on issues such as creating high-quality public spaces and promoting sustainable mobility (German Federal Ministry of the Interior, 2020).</p> <p>Integrated Urban Development Strategies: Leipzig is working towards providing integrated and seamless mobility to ease transportation and reduce emissions (European Commission, 2017). The city is also focusing on developing municipal bioeconomy strategies to transition towards a bio-principled city. These strategies involve a mix of policies and measures aimed at promoting sustainability and resilience (German Federal Ministry of the Interior, 2020).</p> <p>National Urban Development Policy: Germany's National Urban Development Policy is a joint initiative of the federal, state, and local levels. It provides a strategic basis for sustainable urban development, with Leipzig being one of the cities involved in its implementation.</p> <p>Green Ambitions: Leipzig is known for its green ambitions and commitment to preserving green spaces. The city has an average of 254 m² of green space per inhabitant, making it one of Germany's greenest cities (German Federal Ministry of the Interior, 2020).</p>

Maia

Sustainable Cities 2020: Portugal produced Sustainable Cities 2020 (Cidades Sustentáveis 2020), its national principles and guidelines for sustainable urban development, in 2015 (European Commission, 2017). This policy framework emphasizes the need for cities to establish integrated and sustainable urban development strategies and ensure their implementation.

Urban Environmental Sustainability Indicator: A study conducted in Portugal allowed for the development of an urban environmental sustainability indicator through a multi-scale analysis across the country (Vidal et al., 2019). This indicator can help cities like Maia to measure their progress towards sustainability and identify areas for improvement.

Positive Energy Districts: Maia is one of the five cities that are part of the Positive Energy Districts project, which aims to create replicable solutions for sustainable urban development (Fatima Zarrin et al., 2023). This project (SPARCS) focuses on achieving Sustainable Development Goal 11, which aims to “make cities inclusive, safe, resilient, and sustainable.”

Criteria 2: Stakeholder Engagement and Collaboration:

Assessment of the level of stakeholder engagement and collaboration in each city's sustainable urban transformation efforts. Considering the involvement of different stakeholders, such as government agencies, civil society organizations, businesses, academia, and citizens, in decision-making processes, co-creation of solutions, and implementation of projects.

Leipzig

Historical Collaborative Initiatives: The Triangulum project (Triangulum, 2020), a precedent to the SPARCS initiative, set the tone for extensive stakeholder participation in Leipzig, where public utility companies, academic institutions, and civil society actively collaborated on smart city discussions.

Establishment of Dedicated Units for Collaboration: Leipzig's Digital City Unit's conception of a "competence centre" exemplifies the city's commitment to fostering collaboration. This centre is designed to support and interlink NGOs and civil associations, ensuring their seamless integration in digitization processes (Triangulum, 2020).

Empirical Research on Citizen Engagement: Leipzig has not only engaged its citizens but has also strived to understand the drivers behind their participation. Investigations into socio-psychological factors offer insights into why and how citizens engage in smart and sustainable energy management (SPARCS, 2023).

SPARCS and Lighthouse City Designation: As a Lighthouse City in the SPARCS project, Leipzig exhibited robust stakeholder engagement. The city executed several sustainable and energy-efficient measures, often in collaboration with public utilities, companies, and research institutions. This

	<p>collaborative spirit manifests in projects such as the solar thermal plant construction, research on renewable energies, and e-mobility measures (SPARCS, 2022).</p> <p>Lessons from Collaborative Initiatives: Networking and collaboration have been identified as pivotal elements in Leipzig's sustainable urban transformation journey. Building robust networks with stakeholders like public utilities, companies, and research institutions significantly contributes to the city's ability to understand its potential and drive impactful initiatives (Interview).</p> <p>Challenges and Adaptability: Despite challenges like the COVID-19 pandemic, Leipzig showcased resilience by leveraging digital platforms and virtual meetings. This maintained and even strengthened stakeholder interactions and collaborations, highlighting the city's adaptability in engaging stakeholders under adverse conditions (Interview).</p>
<p>Maia</p>	<p>Strategy, Participation, and Challenges: The city has a long-term strategy and sustainable vision for its climate adaptation and mitigation, where goals were developed in cooperation with key stakeholders. Maia shows readiness by analysing its economic dynamics; it actively seeks local stakeholders' expertise where needed. Thus, the municipality's annual expenditures are planned towards a Smart City transition and respond to the citizens' needs in the city development. One of Maia's strengths is the cooperation of municipality stakeholders and cross-sectoral units who are responsible for processing cross-cutting themes, including public participation in the city. The project involved interviews with local stakeholders, including city managers, industries, SME's, entrepreneurs, civil society, and relevant public and private institutions and entities. The participation process, including City Vision 2050, the onsite assessment, and the City Lab Innovation Workshop, helped gain the attention and support of relevant key stakeholders. However, in practice, based on the on-site assessment, The level of stakeholder engagement and collaboration in the city of Maia's sustainable urban transformation efforts is assessed as low and there is limited involvement of stakeholders in decision-making processes, co-creation of solutions, and implementation of projects (D5.4 SPARCS, 2022)</p>
<p>Criteria 3: Institutional Capacity and Leadership:</p> <p>Evaluation of the institutional capacity and leadership in each city to drive sustainable urban transformation. Considering the presence of dedicated departments or units responsible for sustainability, their expertise and resources, and their ability to coordinate and implement transformative initiatives.</p>	
<p>Leipzig</p>	<p>Dedicated Units for Sustainability Initiatives: Leipzig's establishment of the Digital City Unit underscores the city's institutional capacity to drive sustainable urban transformation. The unit is not merely a token gesture but is backed by experts with multifaceted backgrounds in IT, engineering, urban planning, and other relevant fields. Their collective expertise ensures that smart city initiatives are grounded in both technological advancements and urban development realities (SPARCS, 2022).</p>

	<p>Collaborative Projects Highlighting Capacity: Leipzig's engagement in collaborative projects, notably the Triangulum and SPARCS (SPARCS, 2022), emphasizes its capacity and commitment to drive transformation on both a local and international scale. As a Lighthouse City in the SPARCS project (Interview), Leipzig undertook robust measures in sustainable energy and urban development, further proving its leadership in this domain (Triangulum, 2020).</p> <p>Integrated Approach Across City Departments: As illustrated in the D4.3 document, Leipzig operates as an integrated working process across various departments, encompassing traffic, green and blue infrastructure, urban development, climate protection, and environmental protection. This integrated approach ensures that all facets of urban life are considered in sustainable urban transformation strategies (SPACRS D4.3, 2022).</p>
<p>Maia</p>	<p>The institutional capacity of the city of Maia to drive sustainable urban transformation is assessed as medium. The city has a dedicated department for sustainability, but it is relatively small and lacks some expertise and resources. The department is also not well-coordinated with other departments in the city. The leadership of the city of Maia on sustainability is also assessed as medium. The mayor has expressed support for sustainability, but there is no clear vision or strategy for how to achieve it. The city has also not made significant investments in sustainability initiatives (D5.4 SPARCS, 2022).</p> <p>The city of Maia has the potential to drive sustainable urban transformation, but it needs to strengthen its institutional capacity and leadership. This could be done by increasing the size and expertise of the sustainability department, improving coordination between departments, and developing a clear vision and strategy for sustainability.</p>
<p>Criteria 4: Planning and Integration:</p> <p>Assessment of the extent to which sustainability principles are integrated into urban planning processes in each city. Evaluation of the incorporation of sustainability considerations into land use planning, infrastructure development, transportation systems, and housing policies.</p>	
<p>Leipzig</p>	<p>Integrated Urban Development Strategy: Leipzig's commitment to integrating sustainability into urban planning is epitomized by the INSEK Leipzig 2030. Not only does this strategy delve into the traditional facets of urban planning but it also intricately interweaves elements like economic vitality, democratic principles, social unity, and environmental stewardship, presenting a holistic blueprint for the city's future (SPARCS, 2022).</p>
<p>Maia</p>	<p>Land Use Planning: The project assessed the existence of municipal level policies in place for transportation, air quality, and buildings. This suggests that sustainability considerations are being taken into account in land use planning, especially in the areas of transportation, air quality, and buildings.</p>

Infrastructure Development: The project analyses the city's building transformation, which looks into the development of various fields for building performance. This points towards considerations of sustainability in infrastructure development, particularly in the refurbishment of pre-existing stock.

Transportation Systems: The project assesses municipal level policies specifically for transportation. This suggests that sustainability considerations are being integrated into the transportation systems of the city.

Housing Policies: The emphasis on building transformation, especially starting with the refurbishment of pre-existing stock, indicates that there is a focus on sustainable housing policies (D5.4 SPARCS, 2022).

Criteria 5: Financing Mechanisms

Evaluation of the availability and effectiveness of financing mechanisms to support sustainable urban transformation. Considering the presence of innovative funding mechanisms, public-private partnerships, and access to external funding sources for sustainable projects and initiatives.

Leipzig

External Funding for Projects: Leipzig has demonstrated a commendable knack for accessing external funding sources, thereby underlining its strategic approach to financing sustainable urban transformation. Its involvement in the **European Energy Award** (SPARCS, 2022) and the **Triangulum project** (Triangulum, 2020), backed by the European Union's Horizon 2020 research and innovation program, is testament to the city's capacity to attract and secure significant financial support for its initiatives.

Public-Private Collaborations: Leipzig's journey towards becoming a Lighthouse City in the **SPARCS project** illuminates its capability to initiate and sustain meaningful collaborations. Engaging public utilities, companies, and research institutions not only enhances the knowledge reservoir but also possibly expands financial avenues through public-private partnerships (Interview).

Resilience and sustainability in Financing: The city's resilience and adaptability extend to its financing strategies too. Despite potential challenges post the SPARCS project and the looming conclusion of another subsequent project, Leipzig remains unwavering in its commitment, exploring various avenues like external project funding and municipal budget allocations (Interview).

Maia

Innovative Funding Mechanisms: The project identifies various possible funding options, including feasibility studies, investment and funding opportunities, public tenders, and engagement of citizens. This suggests an openness to innovative funding mechanisms that can be tailored to the specific needs and conditions of a given project or initiative.

Public-Private Partnerships: The document mentions the availability of public-private partnerships as possible funding sources. Public-private partnerships (PPPs) are collaborative arrangements

between public and private sector entities, often used to finance and implement large-scale infrastructure projects.

Access to External Funding Sources: The project acknowledges the availability of EU and national funding programs as potential external funding sources. Access to these funding programs can significantly augment the resources available for sustainable projects and initiatives, especially for cities or regions with limited local financial capacities.

Financial and Economic Feasibility: The project includes an analysis of the financial and economic feasibility of the proposed projects, assessing both the costs and benefits. This suggests a systematic approach to ensure that the projects are not only sustainable from an environmental or social perspective but also from a financial standpoint. Furthermore, the analysis of potential sources of funding ensures that the projects are backed by concrete and achievable financial plans.

Criteria 6: Knowledge Sharing:

Assessment of the efforts of each city in promoting knowledge sharing related to sustainable urban transformation. Considering the presence of training programs, workshops, and knowledge exchange platforms to enhance the skills and knowledge of stakeholders involved.

Leipzig

Digital City Unit's Competence Centre: Leipzig's **Digital City Unit** has been at the forefront of fostering knowledge sharing by initiating the development of a "competence centre" (Triangulum, 2020). This centre doesn't just operate in isolation but actively seeks to bridge the digital divide by connecting various societal groups. By targeting NGOs and civil associations, Leipzig ensures that the knowledge base is broadened beyond just the technocrats or urban planners. This inclusivity ensures grassroots-level capacity building, which is integral for holistic urban transformation.

Regular Engagement and Workshops: Beyond formal projects and collaborations, Leipzig also emphasizes regular engagement sessions. Workshops, training programs, and stakeholder meetings serve as platforms where city planners, local businesses, academic researchers, and the general public can share insights, discuss challenges, and brainstorm innovative solutions (SPARCS, 2023).

Maia

Workshops: The SPARCS project mentions the "City Lab Innovation Workshop," which was organized with the aim of promoting knowledge sharing and exchange among stakeholders (D5.4 SPARCS, 2022). This workshop involved a diverse group of representatives from various sectors, indicating a multidisciplinary approach to knowledge sharing. Additionally, the "Living Lab in Maia" is highlighted as a space for co-creation and collaboration with various stakeholders. While not explicitly termed as a workshop, the Living Lab can be seen as an ongoing collaborative workshop platform, integrating different perspectives to identify best practices for sustainable urban transformation (Maia Municipality, 2018).

	<p>Knowledge Exchange Platforms: The Living Lab in Maia serves as a knowledge exchange platform, aiming at co-creation, collaboration, and scaling up successful interventions. The Lab’s design, which integrates social, environmental, and economic aspects, is a testament to its comprehensive approach. Furthermore, its focus on testing, validating, and adapting solutions for broader contexts implies a systematic method of knowledge dissemination and sharing (Maia Municipality, 2018).</p>
<p>Criteria 7: Data and Monitoring:</p> <p>Evaluation of the availability and use of data and indicators to monitor progress towards sustainable urban transformation goals. Assessment of the presence of data collection systems, monitoring frameworks, and the use of data for evidence-based decision-making and policy development.</p>	
<p>Leipzig</p>	<p>INSEK Leipzig 2030 and its Robust Indicator System: Leipzig's Integrated Urban Development Concept (INSEK Leipzig 2030) serves as a foundational document, articulating the city's vision for sustainable transformation. More importantly, it doesn't just set out vague ideals but has a robust system of indicators. These indicators provide measurable metrics related to key sustainability areas such as greenhouse gas emissions, energy consumption, and waste generation. Having such tangible metrics ensures that the city's progress can be quantified and compared against set benchmarks (Triangulum, 2020).</p> <p>The CITYkeys assessment method and the indicators: The CITYkeys assessment method is a framework that was developed as part of the H2020 Smart Cities Framework Initiative to support all the smart city lighthouse projects. Its main goal is to define common indicators for evaluation of the lighthouse projects and to facilitate and enable stakeholders in projects or cities to learn from each other, create trust in solutions, and monitor progress, by means of a common integrated performance measurement framework. The method uses a set of indicators that are organized into five categories: People, Planet, Prosperity, Governance, and Propagation. The People side of sustainability refers to the long-term attractiveness of cities for a wide range of inhabitants and users. The Planet side of sustainability refers to the environmental sustainability of cities. The Prosperity side of sustainability refers to the economic sustainability of cities. The Governance category assesses the importance of a city’s internal and external factors, and the Propagation category assesses the up-scaling potential of the implementations (SPARCS, 2020)</p>
<p>Maia</p>	<p>The Morgenstadt assessment framework: It will provide a structured approach to evaluating the success of smart city projects and monitoring progress towards sustainable urban transformation goals. The framework defines a set of KPIs that can be used to measure the performance of a city across a range of different sectors, including social, economic, and environmental factors. These KPIs can be used to track progress over time and to identify areas where improvements are needed (SPARCS, 2020).</p>

Criteria 8: Innovation and Technology Adoption:

Evaluation of the level of innovation and technology adoption in each city's sustainable urban transformation. Considering the integration of smart city solutions, digital technologies, and innovative approaches to address sustainability challenges and enhance urban liveability.

Leipzig

Triangulum Project: Serving as a touchstone for Leipzig's innovative aspirations, the **Triangulum project** establishes the city as a vanguard in sustainable urban transformation through technology. As a living lab, the project encapsulates the essence of real-world testing, helping the city not only ideate but also understand the practical implications of smart city solutions in real time (Triangulum, 2020).

Holistic Smart City Approach: Leipzig's smart city strategy is not just technologically oriented. It's designed with an acute understanding of current and future urban challenges. By leveraging **connected ICT technologies**, the city aims to address multifaceted issues like population growth, urban densification, and climate change. This fusion of technology with urban development goals ensures that the solutions are not just innovative but also deeply relevant (Triangulum, 2020).

Emphasis on Collaboration and Co-Creation: A unique strength of Leipzig's approach lies in its commitment to collaboration. Recognizing that innovation isn't the sole purview of any single entity, Leipzig fosters **cooperation between the city administration, local businesses, academia, and civil society**. Such a collective endeavour guarantees that solutions are not just technologically advanced but also socio-economically apt (SPARCS, 2023).

Pilot Projects in Leipzig West: Demonstrating its commitment to practical application, Leipzig has embarked on pilot projects, especially in the **Leipzig West** region. By developing these projects through participative processes, the city ensures their efficacy and alignment with community needs. Such grassroots-level tech solutions can serve as prototypes for larger city-wide or even national implementations (Triangulum, 2020).

Maia

Smart City Solutions and Digital technologies: The project includes the "City Digital Transformation" project, which is focused on digital transformation and energy transition. The emphasis on intensifying work and knowledge exchange between partners suggests a collaborative approach towards developing and implementing smart city solutions and there is inclination towards adopting digital technologies.

Innovative Approaches: The project emphasizes the use of new technologies related to energy and building performance. Mentioning these technologies as the "cutting edge" of building transformation indicates that the city is adopting innovative approaches and is willing to invest in the latest technology to enhance sustainability.

Criteria 9: Replicability and Scalability:

Assessment of the potential replicability and scalability of successful sustainable urban transformation initiatives from the Lighthouse City to the Fellow City. Considering the transferability of best practices, lessons learned, and innovative solutions, and their potential to be applied in different urban contexts.

Leipzig **Triangulum Project Learnings:** A cornerstone of Leipzig's sustainable urban transformation, the **Triangulum project** serves not just as a test bed but also as a knowledge bank. The city has been a keen observer, assimilating lessons from three Lighthouse Cities and their experiences in deploying smart city solutions. While the project's primary objective is the creation of holistic smart city solutions encompassing energy, transport, and ICT, its secondary (and equally important) goal is ensuring these solutions have the capacity for replication in diverse urban settings. By focusing on universal themes and broad-based solutions, Leipzig ensures the lessons from Triangulum are not just local but have wider European and global relevance (Triangulum, 2020).

SPARCS Project and Replication plan: The SPARCS project provides a framework and methodology for the scale-up and replication of sustainable urban transformation initiatives from Lighthouse Cities to Fellow Cities. This includes a holistic, modular, and flexible concept that considers the challenges identified in SPARCS and the solutions implemented in the Lighthouse Cities of Espoo and Leipzig. Strategic steps for replication of lighthouse cities are:

- 1 Identification of the most relevant and transferable solutions, best practices, and lessons learned from the Lighthouse Cities.
- 2 Analysis of the local context of the Fellow Cities, including their energy systems, urban planning, and citizen engagement.
- 3 Adaptation of the solutions, best practices, and lessons learned to the local context of the Fellow Cities, taking into account their specific needs, challenges, and opportunities.
- 4 Development of a replication plan, including a timeline, budget, and stakeholders involved.
- 5 Implementation of the replication plan, including monitoring and evaluation of the results (D1.7 SPARCS, 2021).

Maia **SPARCS Project and Replication plan:** The project provides implementation plans for Fellow Cities, including Maia, which contribute to a better replication and scale-up activity methodology that is useful for both the Lighthouse Cities and the Fellow Cities by presenting a structured approach to the sharing of knowledge and experience achieved in the SPARCS Lighthouse Cities. The project also includes monitoring and impact assessment, which contributes to the baseline of the current situation in the cities and provides straightforward identification of possible solutions to be implemented. Finally, the project includes replication activities, such as fellow city replication strategy, project development in fellow city, and upscaling and replication in Lighthouse Cities, to help implement the replication activities (D1.7 SPARCS, 2021)

CHAPTER 4: DISCUSSION OF THE RESULTS AND FINDINGS

This chapter embarks on an in-depth exploration and analysis of the results and findings derived from the interviews, document analysis, and application of the Morgenstadt Model in the context of the Municipality of Maia and the city of Leipzig. The primary objective of this chapter is to delve into the acquired data, presenting a comprehensive understanding of the complexities surrounding sustainable urban development, collaborative initiatives, and organizational capacity building. Through meticulous examination and interpretation, this chapter aims to extract insights, patterns, and implications that illuminate the intricacies of implementing transformative projects in urban environments.

Moreover, this chapter explores the outcomes of the document analysis, which unveils essential insights from project documentation, strategic plans, and collaborative activities within the BaZe and SPARCS projects. These documents and reports which are mainly project reports and deliverables, were fed into the thematic analysis to address the categories that were identified as necessary criteria for successful implementation of Living Lab initiative in Municipality's organizational structure to catalyse the sustainable transformation in cities and towns from literature review and theoretical framework sections.

The global pursuit of urban sustainability underscores the significance of deciphering the practical nuances of sustainable initiatives. This chapter serves as a conduit to the voices and perspectives of key stakeholders, including representatives from the Municipality of Leipzig and external project partners, captured through insightful interviews. These interviews provide a candid portrayal of lived experiences, strategies, and challenges encountered during the endeavour to drive sustainable urban transitions. Together with the document analysis, these interviews enriched the understanding the difference between two cities and facilitated the conduction of comparative analysis.

Finally, this chapter will conclude by providing strengths and shortcomings of Maia, lessons learned from Leipzig and suggesting recommendations which will lead the study to develop a visual roadmap to address the these challenges and recommendations.

4.1 Thematic Analysis Results

This section will systematically identify and assess the strengths as well as the existing shortcomings within Maia's pursuit of a sustainable urban transformation through the Municipality's Living Lab initiative which are summarized in Table 5. All the strengths and shortcomings are classified based on the main categories defined in Table 2.

Table 5: Strengths and Shortcomings of Maia based on Thematic Analysis

Lab's Characteristics	
Strengths	<p>Incorporation of Co-Creation Methodologies: Both SPARCS and BaZe projects emphasize co-creation, utilizing the City Lab methodology and "Co-creation" operations for stakeholder engagement and active project participation.</p> <p>Engagement and Involvement of Diverse Stakeholders: Demonstrates ability to engage a wide range of stakeholders, including civil society, public and private institutions. Notably, the engagement of about 18 civil society members in SPARCS and the initiation of a community movement in BaZe (MeT - Maia in Transition).</p> <p>Citizen-Centric Approach: Strong focus on involving citizens, evidenced by activities like city visioning and workshops in the SPARCS project, underlining the commitment to incorporating citizens' perspectives in sustainability and urban transformation discussions.</p> <p>Collaborative Workshops: SPARCS project workshops illustrate a collaborative approach, bringing together diverse stakeholders for knowledge exchange, ensuring multiple viewpoints in urban transformation roadmap development.</p> <p>Strategic Vision for Sustainability: Reflects foresight and commitment to climate adaptation and mitigation, with local stakeholder involvement in strategy development.</p> <p>Real-World Application of Solutions: The Living Labs, especially Maia Living Lab Central Area and BaZe - Living Lab, serve as practical environments for direct application and testing of innovative solutions, crucial for gauging the effectiveness of sustainability initiatives.</p> <p>Wide Spectrum of Innovative Solutions: Testing a range of solutions, including energy efficiency, renewable energy production, and smart urban infrastructure, to address various sustainability challenges.</p> <p>Technology Integration: Leveraging advanced technologies like vehicle traffic counting systems and air quality monitoring for sustainable urban development.</p>

Addressing Comprehensive Environmental Issues: Solutions such as green roofs, Pay-As-You-Throw, and water irrigation management systems tackle a broad spectrum of environmental issues.

Dynamic Experimentation Platforms: Living Labs as environments for testing innovative solutions like energy efficiency measures, renewable energy production, and sustainable mobility.

Data-Driven Initiatives: Emphasis on data collection from sensors and other sources for informed decision-making and solution refinement.

Adherence to International Standards: Commitment to implementing recognized sustainability practices, particularly ISO 37120 standards.

Learning and Capacity Building: Focus on education and skill development through workshops and training sessions in the BaZe project, fostering stakeholder capacity building.

Tailoring Solutions to City-Specific Needs: Engaging stakeholders in identifying real needs and aligning initiatives with city-specific challenges.

Long-Term Strategic Alignment: Alignment with the "BaZe - Building a Zero Emissions Maia" plan, indicating a commitment to long-term, coherent sustainability goals.

Shortcomings

Challenges in Co-Creation Execution: Encountered practical challenges in co-creation, notably the cancellation of the Co-creation action in the BaZe project due to delays, indicating project management and execution issues.

Limited Stakeholder Involvement in Decision-Making: Despite engagement efforts, there's a gap in effectively integrating stakeholders in decision-making processes, necessitating more effective stakeholder input integration.

Need for Improved Cross-Sectoral Cooperation: Potential exists for enhanced cross-sectoral collaboration, particularly in themes like public participation, to fully leverage cooperative efforts among municipal stakeholders.

Inconsistency Between Planning and Implementation: A notable gap between long-term strategic planning and practical execution, highlighting the need for stronger alignment and effective translation of plans into actions.

Resource and Financial Constraints: Innovative solutions in real-world settings are resource and financially intensive, posing limitations on the scope and sustainability of projects.

Integration Complexities with Urban Infrastructure: Challenges in integrating new technologies and systems into existing urban fabric, particularly in older or established areas.

Stakeholder Engagement and Public Acceptance Issues: Ensuring ongoing stakeholder engagement and public buy-in remains critical and challenging, impacting the adoption and effectiveness of solutions.

Monitoring and Evaluation Difficulties: Continuously monitoring and evaluating dynamic, real-world implementations presents challenges, necessitating accurate and comprehensive data collection.

Intense Resource Needs for Experimentation and Data Collection: Balancing the resource intensity of continuous data collection and experimentation is critical.

Sustaining Long-Term Learning Initiatives: Challenges in ensuring the sustainability and continuous updating of knowledge and skills gained from workshops and training sessions.

Effectiveness Measurement of Learning Programs: Difficulties in quantifying the impact of interactive learning programs on actual practices and behaviour changes.

Resource Constraints Affecting Flexibility: Limited resources can hinder the municipality's ability to test and implement a wide array of solutions, affecting the flexibility of initiatives.

Risk of Overextension: Attempting various solutions might lead to resource and attention weakening, impacting the depth and quality of each initiative.

Feedback Loop and Implementation Delays: Constant strategy adjustments based on feedback can slow down implementation processes.

Maintaining Long-Term Strategic Focus: Challenges in sustaining focus amidst changing political, economic, and social landscapes, with the risk of shifting away from long-term goals.

Adaptability to Rapid Environmental Changes: Maintaining flexibility and responsiveness to environmental changes while preserving a holistic approach.

Participation of Stakeholders and Actors

Strengths

Citizen Involvement in Co-creation: Actively involving citizens in the co-creation process is a significant strength. Their participation in prototyping and experimenting ensures that the solutions developed are closely aligned with their needs and preferences.

Collaboration with Local Governments and Public Authorities: The strategic collaboration with local governments and public authorities integrates the Living Labs within the broader city planning and sustainability goals. This alignment ensures consistency and support at the policy level.

Engagement of Private Sector and Businesses: The involvement of businesses and the private sector brings in market expertise and innovation. Their contributions are vital in developing practical, scalable solutions.

Involvement of Researchers and Academic Institutions: Collaboration with academic institutions ensures that the solutions are research-backed and effectively evaluated. Their role in policy development and impact assessment is crucial for the success of the projects.

Participation of NGOs: NGOs bring diverse viewpoints and represent specific interest groups. Their expertise in advocacy and community engagement enriches the multi-stakeholder approach.

Inclusion of Technology Providers and Startups: Collaborating with technology providers and startups introduces cutting-edge solutions and fosters innovation, crucial for addressing contemporary challenges in energy and sustainability.

Contribution of Urban Planners and Designers: Urban planners and designers contribute essential expertise in spatial planning, enhancing the efficiency and sustainability of urban infrastructure and green spaces.

Financial Institutions and Investors for Scalability: The involvement of financial institutions and investors is key in ensuring the financial sustainability and scalability of the initiatives.

Connection with International Organizations and Networks: Collaborating with international bodies promotes knowledge exchange and global best practices, expanding the impact of the Living Labs beyond the local context.

Interview: Maia's involvement with diverse groups, such as businesses, local governments, and NGOs, showcases comprehensive stakeholder participation.

Shortcomings

Sustaining Long-Term Engagement: Maintaining the engagement and commitment of all stakeholders over the long term, especially as project novelty fades, is a significant challenge.

Risk of Overreliance on External Stakeholders: There's a potential risk of becoming overly reliant on external entities like businesses and investors, which could lead to prioritizing market-driven solutions over community-centric ones.

	<p>Interview: The reliance on a small team for project management points to the need for wider departmental involvement and stakeholder engagement.</p>
<p>Enabler-driven Lab’s approach</p>	
<p>Strengths</p>	<p>Strategic Collaboration with Local Governments and Public Authorities: The Living Labs are integrated within broader city planning and sustainability goals, ensuring consistency and support at the policy level through this strategic collaboration.</p> <p>Urban Planners and Designers Contribution: Their expertise in spatial planning enhances the efficiency and sustainability of urban infrastructure and green spaces.</p> <p>Financial Institutions and Investors for Scalability: Their involvement is crucial in ensuring financial sustainability and scalability of the initiatives.</p> <p>Alignment with Maia’s Strategic City Goals: Integral to Maia’s plan for achieving carbon neutrality by 2050, ensuring initiatives contribute directly to the city's broader sustainability objectives.</p> <p>Support from National and EU Funding Agencies: This external funding supports financial sustainability and allows for ambitious project implementation.</p> <p>Multidisciplinary Collaboration Emphasis: Involves a diverse range of stakeholders from various sectors, enhancing the scope of innovation and enriching the knowledge base.</p> <p>Commitment to Shared Learning and Open Policies: Fosters engagement, co-creation, collaboration, and transparency, promoting the applicability of solutions beyond Maia.</p> <p>Action-Oriented Strategy Development: Focuses on developing strategies through practical actions, testing, and evaluating solutions for adaptive learning.</p> <p>Alignment with Broader Sustainability Goals: Reflects a cohesive urban development approach, integrating social, environmental, and economic aspects.</p> <p>Long-Term Initiative Orientation: The Living Lab is designed for longevity, aligning with the need for sustained effort in complex urban sustainability challenges.</p>
<p>Shortcomings</p>	<p>Challenges in Integration into Regional Development: Effectively integrating initiatives into broader regional development plans and aligning project outcomes with regional goals requires strategic planning and coordination.</p> <p>Risk of Fragmentation: The potential for efforts to become dispersed and lose focus exists, especially with multiple stakeholders and projects involved.</p>

Challenges in Information Integration: Integrating and effectively utilizing data from diverse sources and stakeholders can be complex, with a risk that certain interests may overshadow others.

Challenges in Aligning Stakeholder Interests with Strategy: Aligning diverse stakeholder interests into a cohesive strategic direction is challenging, with a risk of strategy rigidity limiting adaptability to new challenges.

Risk of Goal Misalignment Over Time: There is a risk that the goals and objectives of the Living Lab might drift or become misaligned with evolving city or stakeholder priorities.

Challenges with Technological Advancements: Keeping up with rapid technological changes and integrating the latest advancements in a long-term project can be challenging.

Implementation stages (from FormIT Methodology)

Strengths

Organizational Capacity Building: Forming local teams and engaging with various stakeholders highlights a focus on strengthening organizational capabilities, crucial for the successful and sustainable implementation of projects.

Openness and Accessibility: The project's commitment to openness, demonstrated by involving diverse stakeholders and aiming for accessible policies and solutions, ensures inclusivity and broad reach.

Emphasis on Value Creation: Aligning initiatives with social, environmental, and economic goals underlines a commitment to creating substantial value and moving towards broader sustainability objectives.

Comprehensive Approach to Prototype Design: Involving stakeholders in the design process, including local governments, businesses, and NGOs, ensures prototypes are inclusive, addressing varied needs and perspectives, and covering aspects like functionality and usability.

User-Centric Evaluation: A focus on the interaction between users and services indicates a user-centric approach, essential for ensuring intuitive, user-friendly, and effective solutions.

Real-World Application and Testing: Implementing and testing innovative solutions and technologies in real-world settings demonstrates the municipality's dedication to practical application and real-world impact.

	<p>Deep Understanding in Planning: As highlighted in interviews, there's a profound understanding of the circumstances surrounding sustainable urban development projects, indicating effective and insightful planning.</p>
<p>Shortcomings</p>	<p>Complexity in Planning and Decision-Making: The involvement of numerous stakeholders, beneficial for diversity, can lead to over-complexity in planning, making consensus and effective decision-making challenging.</p> <p>Evaluation of Planning Effectiveness: Developing clear metrics to evaluate the effectiveness of the planning phase, in terms of stakeholder contributions and innovation outcomes, presents a challenge.</p> <p>Transitioning from Planning to Implementation: Ensuring that insights and strategies developed during the planning phase are effectively translated into actionable initiatives can be challenging, highlighting a potential gap in execution.</p> <p>Complexity in Prototype Design: Balancing the diverse inputs and expectations in prototype design can be challenging, with a risk of overcomplicating the design or failing to meet diverse requirements.</p> <p>Risk of Design Overreach: The prototypes might become too generalized in the attempt to create adaptable and standardized solutions, potentially losing effectiveness in specific contexts.</p> <p>Resource and Time Constraints in Design: Effective prototype design, especially in collaborative settings, can be resource and time-intensive, posing a significant challenge.</p>
<p style="text-align: center;">Application of the Morgenstadt Model</p>	
<p>Strengths</p>	<p>Energetic Refurbishment Initiatives: Maia's initiatives in energy-efficient equipment, renewable energy sources, and smart technologies in buildings showcase a commitment to enhancing energy efficiency and reducing consumption.</p> <p>Engagement with Business Actors: Active collaboration with business entities, as seen in projects like "BaZe-Oficina," exemplifies a practical strategy for incorporating private sector capabilities in sustainability efforts.</p> <p>Community Energy Management Focus: The implementation of energy-efficient measures and renewable energy installations at the community level underlines a comprehensive energy management strategy.</p>

	<p>Awareness and Education in Sustainability: Initiatives like the Plan on Environmental Education and the development of sustainability indicators highlight efforts to raise sustainability awareness and promote long-term societal change.</p>
<p>Shortcomings</p>	<p>Slow Pace of Building Refurbishment: The current low rate of building refurbishment in Maia indicates a gap between sustainability goals and actual implementation, underscoring the need for accelerated refurbishment efforts.</p> <p>Challenges in District-Level Management: Effective integration and management of sustainability initiatives at the district level pose challenges, indicating the need for improved local management strategies.</p> <p>Scalability and Replicability of Solutions: The complexity of scaling small-scale projects to broader applications within the city or other contexts requires careful planning and adaptation, highlighting a gap in current strategies.</p> <p>Internal Structural Challenges: Interviews reveal issues with the municipality's internal structure and limited departmental engagement, which could hinder the effectiveness of sustainability transitions.</p> <p>Absence of Flat Hierarchies in City Administration: The lack of initiatives to create flat hierarchies within city administration is a notable gap, potentially impeding effective communication and responsive decision-making.</p> <p>Lack of Structures for Communal Sustainability Management: The absence of dedicated structures for managing communal sustainability efforts suggests a need for more streamlined and centralized organizational frameworks.</p> <p>Scalability and Replicability of Training Programs: The current training programs, while beneficial, face challenges in scalability and replicability across various departments and sectors.</p> <p>Integration of Training into Operations: Integrating the knowledge and skills from training programs into the municipality's daily operations and decision-making processes is crucial but challenging.</p> <p>Continuous Professional Development: Keeping up with the latest sustainability practices and technologies, especially in the face of evolving environmental challenges, is a demanding task that requires ongoing professional development.</p>

In summary, while the Municipality of Maia exhibits strong capabilities in collaborative initiatives, stakeholder participation, and proactive planning for sustainable urban development,

it faces challenges in organizational structure, broader stakeholder engagement, and dependency on external funding.

4.2 Comparative Analysis Results

The comparative analysis acts as a valuable learning tool for Maia, the Fellow City in the SPARCS project, as it examines the experiences of Leipzig, the Light House city. This study aims to uncover the lessons that Maia can draw from Leipzig's achievements and identify the gaps that exist between Maia and Leipzig's experiences. Additionally, this section will offer recommendations based on these insights.

Through the comparison with Leipzig, which serves as a seasoned example, Maia gains insights that can contribute to its own urban development journey. The analysis doesn't just highlight differences; it provides a structured approach for Maia's growth. By carefully assessing the similarities and discrepancies between these two cities, actionable recommendations can be formulated. These recommendations, derived from both Leipzig's successes and Maia's aspirations, provide a framework for a more sustainable and innovative urban development strategy in Maia.

4.2.1. *Lessons Learned from Leipzig*

Holistic Collaboration is Vital: Leipzig's experience underscores the crucial role of collaboration between multiple entities, including city administration, businesses, academia, and civil society. Such collaboration facilitates the pooling of diverse resources and expertise, ensuring more comprehensive and robust sustainable solutions.

Citizen Involvement is Key: Direct engagement and participation of citizens in decision-making processes have been pivotal. Their feedback, ideas, and support drive community-led initiatives and enhance the acceptance and adoption of urban transformations. Moreover, citizen satisfaction becomes a crucial metric in evaluating the success of projects.

Continuous Monitoring and Evaluation: The city identified the importance of ongoing monitoring and evaluation in the sustainable urban transformation journey. By employing key indicators, such as energy efficiency and CO2 emissions, the city could adjust strategies in real-time, ensuring the projects remained on course and met their desired outcomes.

Adaptability and Context Sensitivity: While it's beneficial to adopt best practices from other cities or projects, it's imperative to adapt these solutions to the unique local context. Factors

like cultural nuances, local policies, and economic conditions play a significant role in the success or failure of implemented solutions.

Innovative Business Models and Financing Mechanisms: Sustainable projects often require significant investments, and traditional funding methods may not always suffice. Leipzig learned the importance of developing and employing new business models and financing mechanisms. Engaging both public and private stakeholders in this financial collaboration proved beneficial.

New Governance Structures: Implementing sustainable urban solutions demands new governance structures that promote cross-sectoral coordination and collaboration. Such structures ensure that multiple departments and stakeholders work in harmony, streamlining the planning and execution of projects.

Technology Integration: The success of the Triangulum project underlined the importance of integrating various technologies. A cohesive technological framework that seamlessly merges different systems can significantly amplify the benefits of smart city solutions.

Commitment to Long-term Vision: Achieving sustainable urban transformation is not an overnight endeavour. It requires a commitment to a long-term vision, persistence in the face of challenges, and the agility to adjust strategies as and when needed.

Table 6 explains the main strengths and shortcoming of Maia Municipality compared to Leipzig. The categories are aligned with Table 4 categories and the assessment is focused only on the comparative analysis of Leipzig and Maia.

Table 6: Strengths and Shortcomings of Maia compared to Leipzig

Criteria 1: Policy and Governance Framework	
Strengths	<p>Sustainable Cities 2020 & Urban Environmental Sustainability Indicator: While these initiatives are commendable, they seem more focused on framework development and progress tracking rather than implementing a wide array of sustainability practices. The emphasis appears to be on establishing guidelines and metrics rather than diverse, practical initiatives.</p> <p>Integration with National and International Projects: Maia’s involvement in projects like the Positive Energy Districts indicates an alignment with national and international</p>

	<p>sustainability goals. However, the extent to which these projects are integrated with local policies and other sustainability efforts within Maia is less clear compared to Leipzig.</p> <p>Project-Based Approach: Focusing on specific projects like the Positive Energy Districts could lead to impactful, localized improvements. However, this approach might not be as comprehensive as Leipzig's in addressing a broader range of sustainability challenges across the entire city.</p>
Shortcomings	<p>Innovative Measurement Tools: The development of an urban environmental sustainability indicator is a unique strength. It provides a quantitative way to assess and guide Maia's progress in sustainability, which is crucial for policy evaluation and adjustment.</p> <p>Targeted Sustainability Projects: Engagement in projects like the Positive Energy Districts showcases a proactive approach in specific, potentially high-impact areas. This focused approach can lead to innovative solutions and serve as a model for other cities.</p> <p>Innovative Measurement Tools: The development of an urban environmental sustainability indicator is a unique strength. It provides a quantitative way to assess and guide Maia's progress in sustainability, which is crucial for policy evaluation and adjustment.</p> <p>Targeted Sustainability Projects: Engagement in projects like the Positive Energy Districts showcases a proactive approach in specific, potentially high-impact areas. This focused approach can lead to innovative solutions and serve as a model for other cities.</p>
Criteria 2: Stakeholder Engagement and Collaboration	
Strengths	<p>Long-Term Vision and Strategy Involvement: Maia's development of a long-term strategy for climate adaptation and mitigation, incorporating stakeholder perspectives, is a vital step. This indicates an understanding of the importance of diverse viewpoints in shaping a sustainable future.</p> <p>Cross-Sectoral Cooperation: The cooperation among municipal stakeholders and cross-sectoral units in Maia points to an internal strength in organizational collaboration. This internal cooperation is crucial for effectively managing and implementing sustainability projects.</p>
Shortcomings	<p>Gap Between Strategic Intent and Implementation: The primary shortcoming in Maia is the discrepancy between its strategic plans for stakeholder engagement and the actual on-ground implementation. This gap suggests that while the city recognizes the importance of stakeholder participation, it struggles to translate this into practical, effective engagement.</p>

	<p>Limited Real-World Engagement: The assessment that stakeholder engagement in decision-making and co-creation of solutions is low in Maia indicates a significant area for improvement. Effective stakeholder collaboration is not just about having a strategy in place but also about ensuring active, meaningful participation in all phases of sustainable urban development.</p> <p>Challenges in Integrating Diverse Stakeholders: Maia’s challenge seems to lie in effectively integrating different stakeholders into its sustainable transformation efforts. This includes not only inviting participation but also ensuring that stakeholder inputs are genuinely considered and reflected in policy and project outcomes.</p>
<p>Criteria 3: Institutional Capacity and Leadership</p>	
<p>Strengths</p>	<p>Dedicated Department for Sustainability: The existence of a dedicated department specifically for sustainability in Maia is a fundamental strength. This shows a formal recognition and commitment to sustainable urban development, providing a centralized unit for coordinating sustainability initiatives.</p> <p>Long-Term Vision and Strategy Involvement: Despite some challenges, Maia’s approach to developing a long-term strategy for climate adaptation and mitigation shows an understanding of the importance of strategic planning in sustainability efforts. This indicates an awareness of the need for a forward-thinking and comprehensive approach to urban sustainability.</p> <p>Mayor’s Support for Sustainability: The mayor's expressed support for sustainability is a positive sign. Political backing at such a high level can be instrumental in driving policy changes and garnering wider support for sustainability initiatives within the city.</p>
<p>Shortcomings</p>	<p>Limited Departmental Resources and Expertise: Maia’s sustainability department, being relatively small and lacking in some areas of expertise, faces challenges in driving comprehensive and effective sustainability initiatives. This limitation can hinder the city's ability to respond to complex sustainability challenges.</p> <p>Inadequate Inter-Departmental Coordination: The limited coordination between the sustainability department and other city departments in Maia can lead to fragmented and less impactful sustainability efforts. Effective transformation requires a coordinated approach across various municipal functions.</p> <p>Need for Stronger Leadership and Investment: While there is political support for sustainability, transforming this support into concrete actions and investments is essential.</p>

	Strong leadership commitment, backed by strategic investments and policy directives, is necessary to advance Maia’s sustainability agenda.
Criteria 4: Planning and Integration	
Strengths	Potential for Integrated Planning: Given Maia's involvement in sustainability projects and initiatives, there is potential for the city to integrate sustainability principles into its urban planning processes. This could involve adopting practices similar to Leipzig’s, tailored to Maia’s unique urban context.
Shortcomings	Lack of Detailed Strategy Documentation: Unlike Leipzig's detailed INSEK 2030 strategy, there is no public ally available similar comprehensive planning document for Maia. This absence suggests a potential gap in fully integrated, holistic urban planning.
Criteria 5: Financing Mechanisms	
Strengths	Potential for Innovative Financing: Given Maia’s involvement in sustainability projects, there is potential for the city to adopt innovative financing mechanisms, similar to Leipzig’s, to support its sustainability initiatives.
Shortcomings	<p>Limited Evidence of Public-Private Collaborations: There’s no explicit mention of Maia engaging in public-private partnerships or collaborations to the extent of Leipzig’s involvement, which could limit its ability to secure additional financing and resources for sustainable projects.</p> <p>Potential Gap in External Funding Access: Without clear documentation of accessing external funding sources like EU grants or national programs, Maia may be missing out on substantial financial support opportunities available to cities for sustainable development.</p>
Criteria 6: Knowledge Sharing	
Strengths	<p>Innovative Platforms for Collaboration: The Living Lab in Maia is a notable strength. It provides a dynamic space for stakeholders to collaborate, test, and refine sustainable solutions, making it an effective platform for practical knowledge exchange.</p> <p>Multidisciplinary Workshops: The City Lab Innovation Workshop demonstrates Maia's effort to involve diverse stakeholders in knowledge sharing, which is crucial for understanding and addressing the multifaceted nature of sustainable urban transformation.</p>

Shortcomings	<p>Broader Outreach and Inclusivity: While Maia's initiatives are commendable, there may be room for expanding the reach of its knowledge sharing platforms to include a broader range of stakeholders, mirroring Leipzig's approach to inclusivity.</p> <p>Enhancing Visibility and Accessibility: Ensuring that knowledge sharing initiatives are well-publicized and accessible to all community members, including those who might not traditionally participate in urban planning discussions, could further strengthen Maia's approach.</p> <p>Systematic Documentation and Dissemination: Developing a more systematic approach to documenting and disseminating the knowledge and insights gained from these initiatives could enhance the long-term impact of Maia's knowledge sharing efforts.</p>
Criteria 7: Data and Monitoring	
Strengths	<p>Structured Monitoring Framework: The adoption of the Morgenstadt framework indicates Maia's commitment to a structured approach for monitoring its smart city projects. This structured approach is essential for systematic evaluation and progress tracking.</p> <p>Comprehensive KPIs: The framework's inclusion of diverse KPIs across multiple sectors ensures that Maia's monitoring and evaluation process is comprehensive, covering social, economic, and environmental aspects.</p>
Shortcomings	<p>Comparatively Less Diverse Indicators: While Maia's Morgenstadt framework is comprehensive, it may not be as diverse in scope as Leipzig's CITYkeys, which includes additional dimensions like Governance and Propagation, offering a more holistic evaluation.</p>
Criteria 8: Innovation and Technology Adoption	
Strengths	<p>Commitment to Digital Transformation: Maia's focus on digital transformation, particularly in energy transition, highlights its commitment to integrating modern technologies into its urban fabric.</p> <p>Investment in New Technologies: By emphasizing cutting-edge technologies in building performance, Maia demonstrates its readiness to adopt innovative approaches for sustainability, which is crucial in a rapidly evolving technological landscape.</p>
Shortcomings	<p>Potentially Narrower Scope of Innovation: While Maia is adopting new technologies, its scope of innovation might be narrower compared to Leipzig's holistic approach, which integrates technology into diverse urban challenges.</p>

Criteria 9: Replicability and Scalability	
Strengths	<p>Access to Lighthouse City Experiences: The participation in SPARCS allows Maia to leverage experiences and lessons from Lighthouse Cities like Leipzig, which is instrumental in understanding what works and how to adapt these strategies to its unique urban context.</p> <p>Impact Assessment and Monitoring: The focus on impact assessment within the SPARCS framework offers Maia a systematic way to measure the effectiveness of various solutions, ensuring that only the most effective practices are considered for replication.</p>
Shortcomings	<p>Potential Resource and Capacity Constraints: Implementing and scaling up solutions from Lighthouse Cities might require resources and capacities that Maia may currently lack, including technical expertise, financial investment, and administrative support.</p>

In a comparative analysis of Leipzig and Maia across multiple criteria crucial for sustainable urban transformation, Leipzig emerges as a benchmark with its well-established policy frameworks, effective stakeholder engagement, strong institutional capacity, and a holistic approach to integrating sustainability in urban planning and technology. The city’s involvement in projects like Triangulum and SPARCS underscores its leadership and innovative practices. Maia, while active in projects such as SPARCS and showing commitment to digital transformation and sustainability, faces challenges in areas like comprehensive stakeholder involvement, institutional capacity, and the integration of sustainability in planning. However, its participation in SPARCS and initiatives for digital transformation display significant potential. By leveraging lessons from Leipzig and adapting them to its unique context, Maia can enhance its approach to sustainable urban development, addressing current shortcomings and reinforcing its strengths.

4.2. Recommendations

Based on the assessment of the Municipality of Maia's Living Lab initiative and refining the shortcoming and gaps to avoid repetitiveness, here are the recommendations categorized by criteria, highlighting both strengths and areas for improvement:

Lab’s Characteristics

Based on the characteristics of Living Labs, a series of recommendations could be suggested to enhance their effectiveness in addressing urban sustainability challenges. Firstly, it would be

advised to **enhance co-creation processes**, ensuring a more comprehensive involvement of stakeholders in decision-making. This should be coupled with **streamlined project management** to address practical execution challenges, while maintaining consistency between planning and implementation. Additionally, **expanding the scope of solutions in Living Labs** is essential to cover a broader range of urban challenges, along with addressing scalability and replicability concerns to allow successful experiments to be applied city-wide.

A key recommendation is to **strengthen the integration of experimental approaches within broader urban policies**, complemented by enhanced resources and support for continuous learning initiatives, thus ensuring long-term sustainability. It's also important to **balance resource allocation to avoid overextending across multiple initiatives** and to **develop structured feedback loops** to minimize implementation delays and improve solution adaptability.

Maintaining a strategic focus, particularly in the face of changing landscapes, and ensuring resource allocation aligns with long-term goals is crucial. This includes adapting to technological and environmental changes while keeping stakeholders continuously engaged. Finally, **developing strategies to balance diverse interests and needs across social, environmental, and economic aspects** is recommended, along with **improving mechanisms for measuring and monitoring integrated impacts**, ensuring a holistic and effective approach to urban sustainability through Living Labs.

Participation of Stakeholders and Actors

Regarding the participation of stakeholders and actors in Living Labs, a critical recommendation is to **strengthen stakeholder management**. This involves **balancing diverse interests** to enhance collaboration across various groups involved in urban sustainability projects. A key aspect of this approach is **addressing the risk of overreliance on external stakeholders**. It's essential to develop robust methods for measuring the impact of stakeholder participation. These measures will not only quantify the contributions of different stakeholders but also ensure that their involvement leads to meaningful and effective outcomes. Such an approach is vital for creating a collaborative environment where all voices are heard and integrated into the decision-making process, leading to more comprehensive and sustainable urban solutions.

Enabler-driven Lab's Approach

The recommendations for an enabler-driven lab's approach will emphasize on the importance of **aligning diverse stakeholder interests into a cohesive strategic direction**. This alignment is crucial for ensuring effective collaboration and sustaining long-term engagement. A significant focus should be on **addressing the overreliance on external funding sources**, which is essential for the financial sustainability of lab initiatives. Moreover, **integrating lab solutions and results into regional development** poses challenges that need to be addressed to ensure the continuity and sustainability of initiatives even after the funding period has ended.

Improving information integration is also key. It's important to address the challenges in sustaining engagement and collaboration, ensuring that knowledge integration is cohesive and effective. This approach should be flexible enough to address potential rigidity in strategy and align the interests of a diverse group of stakeholders.

Furthermore, **bridging the gap between strategic planning and implementation** is essential. **Developing robust mechanisms for measuring progress and impact** will not only help in assessing the effectiveness of the initiatives but also in making informed decisions and adjustments as needed. These recommendations collectively aim to strengthen the framework and operational efficacy of enabler-driven labs, making them more responsive and adaptable to the dynamic needs of sustainable urban development.

Implementation Stages (FormIT Methodology)

In relation to the implementation stages, particularly focusing on the FormIT Methodology, key recommendations are to enhance the planning and execution phases. A primary concern is **addressing potential over-complexity in planning**. To tackle this, it is recommended to **develop metrics that can effectively measure the effectiveness of planning**. These metrics should serve as tools to streamline the planning process, ensuring it is both efficient and comprehensive. Additionally, a **smooth transition from planning to implementation** is crucial to maintain continuity and momentum.

Another critical aspect is the **management of complexities in balancing stakeholder inputs and mitigating the risks of prototype design overreach**. This involves carefully considering the perspectives and contributions of all stakeholders while ensuring that the design process remains focused and aligned with the project objectives. **Managing resource and time constraints effectively** is also a significant recommendation. This ensures that projects stay on track and resources are utilized optimally. Ensuring a **smooth transition from prototype**

design to implementation is key, requiring a well-coordinated approach that takes into account all aspects of the project lifecycle, from initial conception to final execution. These recommendations aim to enhance the efficiency and effectiveness of the implementation stages in Living Labs, thereby leading to more successful project outcomes.

Application of the Morgenstadt Model

The application of the Morgenstadt Model brings forward important recommendations to enhance urban sustainability efforts. A pivotal recommendation is to **accelerate building refurbishment efforts**, which involves addressing **district-level management challenges** to ensure more efficient and sustainable urban development. Securing adequate resources and funding is crucial for the realization of ambitious sustainability projects, and there is a need to ensure that the solutions developed are scalable and replicable across different urban contexts.

Another significant aspect of implementing the Morgenstadt Model is **addressing organizational structures within city administration**. This includes the challenge of the absence of flat hierarchies and the need for more effective structures for communal sustainability management. **Enhancing the scalability and replicability of training programs** is also recommended. This involves **integrating training programs into the everyday operations of city administration** and other relevant organizations. Such integration ensures that sustainability practices are ingrained in the regular workflow, leading to a more sustained and impactful implementation of sustainability initiatives. These recommendations aim to fortify the application of the Morgenstadt Model in urban settings, leading to more structured, efficient, and widespread adoption of sustainable practices.

Leipzig Experience

- **Holistic Collaboration:** Foster stronger collaboration across multiple sectors, including city administration, businesses, academia, and civil society. This approach facilitates pooling diverse resources and expertise, ensuring more comprehensive and robust sustainable solutions.
- **Expand Institutional Capacity:** Enhance the resources and expertise of Maia's sustainability department. This may involve increasing staffing, providing specialized training, and ensuring better coordination with other city departments.

- **Continuous Monitoring and Evaluation:** Establish a robust system for ongoing monitoring and evaluation. Use key indicators, such as energy efficiency and CO2 emissions, to adjust strategies in real-time and ensure projects remain on course to meet their desired outcomes.
- **Adaptability and Context Sensitivity:** Customize best practices and solutions to fit Maia's unique local context, considering cultural nuances, local policies, and economic conditions. This ensures the success and relevance of implemented solutions.
- **New Governance Structures;** Implement new governance structures that promote cross-sectoral coordination and collaboration. Such structures ensure multiple departments and stakeholders work harmoniously, streamlining the planning and execution of sustainable urban solutions.
- **Technology Integration:** Integrate various technologies cohesively to amplify the benefits of smart city solutions. A unified technological framework significantly enhances the efficacy of sustainable urban initiatives.
- **Commitment to Long-term Vision:** Strengthen commitment to a long-term vision for sustainable urban transformation. Maintain persistence in the face of challenges and adapt strategies as needed to align with evolving circumstances.
- **Ensure Replicability and Scalability:** Focus on the adaptability of successful initiatives from other cities, customizing them to fit Maia's local context, and building capacities to support replication and scaling up.
- **Engage in Collaborative Learning:** Participate actively in networks and initiatives like SPARCS for collaborative learning, benchmarking, and adapting best practices from Lighthouse Cities.

4.3. Roadmap to achieve the urban sustainability through urban living lab

Creating a visual roadmap for these recommendations involves categorizing them into phases or steps, reflecting their progression from initial planning to long-term sustainability. The structures are as follow:

1. Initial Planning and Stakeholder Engagement:

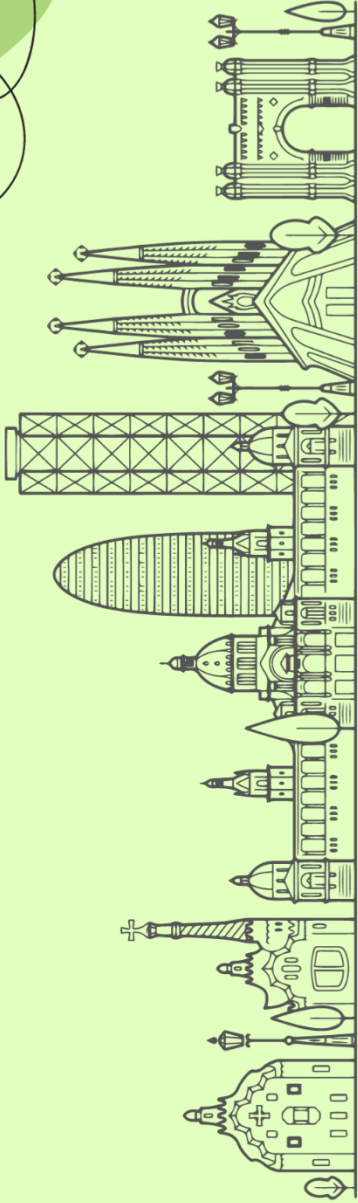
- Enhance co-creation processes with comprehensive stakeholder decision-making involvement.
 - Develop strategies to balance diverse interests across social, environmental, and economic aspects.
- 2. Project Management and Implementation:**
- Address practical challenges in execution by streamlining project management.
 - Develop a structured feedback loop to minimize implementation delays and improve adaptability.
 - Ensure consistency between planning and implementation.
 - Address potential rigidity in strategy and over-complexity in planning.
- 3. Innovation and Solution Expansion:**
- Expand the scope of solutions in Living Labs to cover diverse urban challenges.
 - Implement new governance structures promoting cross-sectoral coordination.
- 4. Policy Integration and Urban Governance:**
- Strengthen the integration of experimentation with broader urban policies.
 - Address challenges in integrating Lab solutions into regional development.
- 5. Scalability and Replicability:**
- Address scalability and replicability concerns for city-wide application.
 - Secure resources and funding for ambitious projects.
- 6. Organizational Capacity Building:**
- Enhance resources and support for continuous learning initiatives.
 - Balance resource allocation to prevent overextension across multiple initiatives.
 - Develop methods to effectively measure the impact of stakeholder participation.
- 7. Technological and Environmental Adaptation:**
- Adapt to technological and environmental changes while keeping stakeholders engaged.
 - Focus on the adaptability of successful initiatives from other cities.
- 8. Long-Term Sustainability and Strategic Focus:**
- Maintain strategic focus amid changing landscapes, ensuring alignment with long-term goals.
 - Address overreliance on external funding sources and strengthen commitment to a long-term vision for sustainable urban transformation.
- 9. Measurement and Monitoring:**

- Improve mechanisms for measuring and monitoring integrated impacts.
- Establish a robust system for ongoing monitoring and evaluation.

10. Community Engagement and Governance:

- Foster stronger collaboration across sectors, including city administration, businesses, academia, and civil society.
- Enhance the resources and expertise of relevant departments.

This roadmap is visualized illustrating each phase leading to the next, reflecting the progression from initial planning to long-term sustainability in next page. The roadmap emphasizes a comprehensive and integrated approach, ensuring that all aspects of living labs and urban sustainability are addressed systematically.



ROADMAP

FROM URBAN LIVING LAB TO URBAN TRANSFORMATION

1 Initial Planning and Stakeholder Engagement

- Enhance co-creation processes with comprehensive stakeholder decision-making involvement.
- Develop strategies to balance diverse interests across social, environmental, and economic aspects.

1

3

3 Innovation and Solution Expansion

- Expand the scope of solutions in Living Labs to cover diverse urban challenges.
- Implement new governance structures promoting cross-sectoral coordination.

5

5 Scalability and Replicability:

- Address scalability and replicability concerns for city-wide application.
- Secure resources and funding for ambitious projects.

4

4 Policy Integration and Urban Governance

- Strengthen the integration of experimentation with broader urban policies.
- Address challenges in integrating Lab solutions into regional development.

6

6 Organizational Capacity Building

- Enhance resources and support for continuous learning initiatives.
- Balance resource allocation to prevent overextension across multiple initiatives.
- Develop methods to effectively measure the impact of stakeholder participation.

7

7 Technological and Environmental Adaptation

- Adapt to technological and environmental changes while keeping stakeholders engaged.
- Focus on the adaptability of successful initiatives from other cities.

9

9 Measurement and Monitoring

- Improve mechanisms for measuring and monitoring integrated impacts.
- Establish a robust system for ongoing monitoring and evaluation.

10

10 Community Engagement and Governance

- Foster stronger collaboration across sectors, including city administration, businesses, academia, and civil society.
- Enhance the resources and expertise of relevant departments

8

8 Long-Term Sustainability and Strategic Focus

- Maintain strategic focus amid changing landscapes, ensuring alignment with long-term goals.
- Address overreliance on external funding sources and strengthen commitment to a long-term vision for sustainable urban transformation.

4.4. Answer to research questions

This thesis embarks on a comprehensive journey to investigate the factors contributing to the effective implementation of living lab-driven technological solutions for sustainable transition within urban contexts, while also identifying the most challenging barriers that impede the realization of this goal. The exploration begins in Chapter 1, where we delve into the foundational concepts that underpin our investigation. Living labs, serving as innovative platforms for testing and refining technological solutions within real urban environments, stand at the core of our study. These labs facilitate collaboration among stakeholders, propelling sustainable transformations. In parallel, we explore the concept of sustainability transition, which involves the transition of urban systems towards more environmentally and socially responsible models, and capacity building, which addresses the development of the necessary skills, knowledge, and resources for enacting transformative change. By establishing a clear understanding of these concepts, we lay a solid groundwork to delve into the intricate factors that shape the implementation of living lab-driven solutions.

Chapter 3 then illuminates the role of qualitative research methods in shedding light on the nuanced dynamics underlying the implementation of living lab-driven technological solutions. Through techniques such as interviews and document analysis, qualitative methods provide a comprehensive understanding of stakeholders' perspectives, challenges, and strategies. This qualitative lens allows us to uncover the multifaceted factors that either foster or hinder the effective implementation of technological solutions in urban contexts. By embracing these qualitative research methods, we unveil complexities that often remain obscured in quantitative approaches, offering a holistic view of the intricate dynamics at play.

Finally, Chapter 4 unfolds as the pinnacle of our investigation. Here, the Morgenstadt methodology takes centre stage as we meticulously assess the sustainability efforts of the Maia Living Lab and draw insights from the experiences of Leipzig, the Light House city within the SPARCS project. Applying this methodology, we uncover the strengths and gaps in Maia's approach to urban transformation, shedding light on factors that enhance effective implementation. Additionally, by comparing Maia's trajectory with Leipzig's achievements, we derive valuable lessons that Maia can leverage for its own journey. As we navigate through these chapters, we bridge the theoretical and practical aspects of our research, weaving together the foundational concepts, qualitative exploration, and empirical analysis.

This research endeavours to dissect the factors that bolster the successful implementation of living lab-driven technological solutions within urban settings, while also identifying the formidable barriers that impede the realization of this objective.

The identified strengths underscore the pivotal role of collaboration and co-creation, where Maia's emphasis on involving stakeholders, both in the SPARCS and BaZe projects, emerges as a significant driving force. Stakeholder engagement, pursued with fervour, becomes a linchpin, fostering comprehensive participation from civil society, city managers, and public and private institutions. This approach translates into an enriched ecosystem of diverse expertise and perspectives, which in turn nurtures successful implementation.

Moreover, Maia's dedication to real-world experimentation within Living Labs emerges as another relevant factor. These spaces serve as incubators for innovation, allowing the practical testing and fine-tuning of solutions within authentic urban environments. The alignment of Living Labs with broader strategic plans, coupled with a focus on holistic integration and long-term perspectives, further substantiates Maia's commitment to sustainable urban transformation. The cohesive blend of social, environmental, and economic dimensions ensures a balanced and enduring approach.

However, the study also acknowledges challenges that stand as barriers to effective implementation. The exploration of these gaps provides essential insights. Challenges in the execution of co-creation initiatives, as highlighted by the cancellation of the BaZe project's co-creation action, underscore the necessity of streamlined processes and enhanced execution methodologies. The discrepancy between Maia's current building refurbishment rate and the targeted value accentuates an area of concern, suggesting the need for more robust strategies in achieving building sustainability objectives.

In tandem with the examination of Maia's journey, this thesis casts a comparative glance toward Leipzig, the Light House city within the SPARCS project. The lessons drawn from Leipzig's experiences cast light on factors that bolster effective implementation. The emphasis on holistic collaboration, citizen involvement, adaptability to local contexts, innovative financing mechanisms, and sustained commitment stand out as universal lessons. While Maia's strengths include the implementation of energy districts, strategic vision, innovation, and replicability, areas like policy depth, stakeholder engagement, and institutional capacity pose challenges that require attention.

Through this comprehensive investigation, we address our research question and sub-questions, culminating in a nuanced understanding of the multifaceted factors influencing the implementation of living lab-driven technological solutions in urban contexts, as well as strategies to overcome the encountered challenges.

4.5. Final Remarks, Conclusion, Limitations, and Future Work Recommendations

Finally, this study goes into the delicate world of factors influencing the effective implementation of living lab-driven technology solutions in urban situations. The journey takes in qualitative approaches, theme analysis, and comparative views from Leipzig, revealing both strengths and weaknesses in Maia's approach. Notably, co-creation, stakeholder participation, in-person experimentation, and long-term vision emerge as key strengths, highlighting the paths to success. Obstacles in co-creation execution and building refurbishment rates, on the other hand, indicate gaps that require strategic correction.

While this work makes useful contributions, it is important to recognize its limits. The study's scope and depth have been impacted by the study's unavailability of relevant documents owing to project amendments and extensions, as well as external circumstances such as maternal leave and holiday season influencing direct contact with the key responsible for Maia Living Lab department. As a result, interpretations should be handled with caution, keeping potential inaccuracy in practicality of projects in mind.

Moving forward, intriguing avenues for further exploration. A focused inquiry into the H2020 project "EHHUR" (Eyes, Hearts, Hands for Urban Revolution) could potentially address the identified challenges and gaps more comprehensively, offering an updated perspective on Maia's urban sustainability initiatives. Putting more effort into the reasons behind co-creation execution challenges and building refurbishment rates could unravel actionable insights to surmount such obstacles in future living lab endeavours.

REFERENCES

- Almirall, E., Lee, M., & Wareham, J. (2012). Mapping Living Labs in the Landscape of Innovation Methodologies. *Technology Innovation Management Review*, 2(9).
<https://doi.org/10.22215/timreview603>
- Almirall, E., & Wareham, J. (2008). Living Labs and open innovation: roles and applicability. *The Electronic Journal for for Virtual Organizations and Networks*, 10(3).
- Amenta, L., & Attademo, A. (2016). Circular wastescapes. Waste as a resource for periurban landscapes planning. *CRIOS*, 12. <https://doi.org/10.3280/crios2016-012008>
- Archibald, M., Wiebe, S., Rieger, K., Linton, J., & Woodgate, R. (2021). Protocol for a systematic review of living labs in healthcare. In *BMJ Open* (Vol. 11, Issue 2).
<https://doi.org/10.1136/bmjopen-2020-039246>
- Baccarne, B., Mechant, P., & Schuurman, D. (2014). *Empowered Cities? An Analysis of the Structure and Generated Value of the Smart City Ghent*. 157–182.
https://doi.org/10.1007/978-3-319-06160-3_8
- Bifulco, F., Tregua, M., & Amitrano, C. C. (2017). Co-governing smart cities through living labs. Top evidences from EU. *Transylvanian Review of Administrative Sciences*, 2017(50E), 21–37. <https://doi.org/10.24193/TRAS.2017.0002>
- Bogdan, Robert, Biklen, K. S. (2007). Qualitative research for education : an introduction to theories and methods | Bogdan, Robert; Biklen, Sari Knopp | download. In *Alien and Bacon, Inc, New York*.
- Bowen, G. A. (2021). Document Analysis as a Qualitative Research Method | Glenn A Bowen - Academia.edu. *Qualitative Research Journal*.
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2). <https://doi.org/10.1191/1478088706qp063oa>
- BROWN JS. (1992). Research that reinvents the corporation. *MCKINSEY QUARTERLY*, 78–95. <https://elibrary.ru/item.asp?id=1714298>
- Bryson, J., & George, B. (2020). *Strategic Management in Public Administration*. Acrefore.
https://www.researchgate.net/publication/337472823_Strategic_Management_in_Public_Administration
- Bulkeley, H. (2010). Cities and the governing of climate change. *Annual Review of Environment and Resources*, 35, 229–253. <https://doi.org/10.1146/ANNUREV-ENVIRON-072809-101747>
- Bulkeley, H., Coenen, L., Frantzeskaki, N., Hartmann, C., Kronsell, A., Mai, L., Marvin, S., McCormick, K., van Steenberg, F., & Voytenko Palgan, Y. (2016). Urban living labs: governing urban sustainability transitions. *Current Opinion in Environmental Sustainability*, 22, 13–17. <https://doi.org/10.1016/J.COSUST.2017.02.003>
- Burbridge, M. (2017). If Living Labs are the Answer - What's the Question? A Review of the Literature. *Procedia Engineering*, 180, 1725–1732.
<https://doi.org/10.1016/j.proeng.2017.04.335>

- Bylund, J., Riegler, J., & Wrangsten, C. (2020). *Are urban living labs the new normal in co-creating places?* <https://doi.org/10.24140/2020-sct-vol.4-0>
- Chesbrough H. W. (2004). Open Innovation: The New Imperative for Creating and Profiting from Technology. *European Journal of Innovation Management*, 7(4), 325–326. <https://doi.org/10.1108/14601060410565074>
- Chronéer, D., Ståhlbröst, A., & Habibipour, A. (2019). Urban Living Labs: Towards an Integrated Understanding of their Key Components. *Technology Innovation Management Review*, 9(3), 50–62. https://www.academia.edu/72374280/Urban_Living_Labs_Towards_an_Integrated_Understanding_of_their_Key_Components
- Compagnucci, L., Spigarelli, F., Coelho, J., & Duarte, C. (2021). Living Labs and user engagement for innovation and sustainability. *Journal of Cleaner Production*, 289. <https://doi.org/10.1016/j.jclepro.2020.125721>
- Concilio, G., & Rizzo, F. (2016). Human Smart Cities Rethinking the Interplay between Design and Planning. *Human Smart Cities Rethinking the Interplay between Design and Planning*, 16(1).
- Creswell J. David, & Creswell John W. (2017). *Research Design Qualitative, Quantitative, and Mixed Methods Approaches*. SAGE Publications.
- D1.7 SPARCS. (2021). *D1.7 Scaling Up and Replication Guideline*.
- D5.4: *Implementation Plan Maia*. (2022).
- D5.4 SPARCS. (2022). *D5.4 Implementation Plan Maia*.
- Denzin, N. K., & Lincoln, Y. S. (2006). The Sage Handbook of Qualitative Research, 2nd ed. Edited by Norman K. Denzin, and Yvonna S. Lincoln. *Library*, 28(August).
- Eade, D. (2005). *Capacity-Building An Approach to People-Centred Development*. 226. https://books.google.com/books/about/Capacity_building.html?id=tnSTMrh2ga0C
- Ehn, P. (1988). *Work-oriented design of computer artifacts*. 496.
- Ehnert, F., Frantzeskaki, N., Barnes, J., Borgström, S., Gorissen, L., Kern, F., Strenchock, L., & Egermann, M. (2018). The acceleration of urban sustainability transitions. *Sustainability (Switzerland)*, 10(3). <https://doi.org/10.3390/SU10030612>
- Eriksson, M., Niitamo, V. P., Kulkki, S., & Hribernik, K. A. (2016). Living labs as a multi-contextual R&D methodology. *2006 IEEE International Technology Management Conference, ICE 2006*. <https://doi.org/10.1109/ICE.2006.7477082>
- Eschenbächer, J., Thoben, K.-D., & Turkuma, P. (2010). Choosing the best model of living lab collaboration for companies analysing service innovations. *Projectics / Proyéctica / Projectique*, n° 5(2), 11–39. <https://doi.org/10.3917/proj.005.0011>
- European Commission. (2017). *Making globalisation profitable*. Office for Official Publications of the European Communities. <https://libguides.ucentralasia.org/c.php?g=720037&p=5133942>

- European Commission, D.-G. for R. and U. P. (2013). *Guide to social innovation*.
<https://data.europa.eu/doi/10.2776/72046>
- Evans, J., Karvonen, A., & Raven, R. (2016). The experimental city. *The Experimental City*, 1–12.
https://www.academia.edu/37215685/The_experimental_city_new_modes_and_prospects_of_urban_transformation
- Fatima Zarrin, Marielisa Padilla, Michal Kuzmic, Aapo Huovila, Gretel Schaj, & Niklas Effenberger. (2023). Positive Energy Districts: The 10 Replicated Solutions in Maia, Reykjavik, Kifissia, Kladno and Lviv. *Smart Cities* 6, 1, 1–18.
- Fischer, G. (2001). *Communities of Interest: Learning through the Interaction of Multiple Knowledge Systems*.
- Foray, D., Goddard, J., Beldarrain, X. G., Landabaso, M., McCann, P., Morgan, K., Nauwelaers, C., & Ortega-Argilés, R. (2012). *Guide to Research and Innovation Strategies for Smart Specialization (RIS3)*. March 2012, 114.
<https://doi.org/10.2776/65746>
- Frantzeskaki, N., & Kabisch, N. (2016). Designing a knowledge co-production operating space for urban environmental governance—Lessons from Rotterdam, Netherlands and Berlin, Germany. *Environmental Science and Policy*, 62.
<https://doi.org/10.1016/j.envsci.2016.01.010>
- Frantzeskaki, N., van Steenbergen, F., & Stedman, R. C. (2018). Sense of place and experimentation in urban sustainability transitions: the Resilience Lab in Carnisse, Rotterdam, The Netherlands. *Sustainability Science*, 13(4), 1045–1059.
<https://doi.org/10.1007/s11625-018-0562-5>
- Fraunhofer IAO. (2022). *Morgenstadt: Creating the cities of tomorrow*.
<https://www.iao.fraunhofer.de/en/research/urban-systems-engineering/morgenstadt-creating-the-cities-of-tomorrow.html>
- Gascó, M. (2017). Living labs: Implementing open innovation in the public sector. *Government Information Quarterly*, 34(1). <https://doi.org/10.1016/j.giq.2016.09.003>
- Gasco-Hernandez, M., Nasi, G., Cucciniello, M., & Hiedemann, A. M. (2022). The role of organizational capacity to foster digital transformation in local governments: The case of three European smart cities. *Urban Governance*, 2(2), 236–246.
<https://doi.org/10.1016/J.UGJ.2022.09.005>
- Georges, A., Baccarne, B., Logghe, S., & Schuurman, D. (n.d.). *Field observations in a living lab context: constructing a framework for the observers' role based on a comparative case study analysis*.
- German Federal Ministry of the Interior, B. and C. (2020). *The new Leipzig Charter*.
https://www.bmi.bund.de/SharedDocs/downloads/EN/eu-presidency/gemeinsame-erklarungen/new-leipzig-charta-2020.pdf?__blob=publicationFile&v=8
- Global Commission Economic Advisory Panel, Kahneman, D., & Spence, M. (2014). *The New Climate Economy Partnership: -to re-examine the link between economic growth and climate action-to provide practical lessons for economic decision-makers*.

- Grotenhuis, F. D. J. (2017). Living labs as service providers: From proliferation to coordination. *Global Business and Organizational Excellence*, 36(4), 52–57. <https://doi.org/10.1002/joe.21790>
- Guest, G., MacQueen, K., & Namey, E. (2014). Applied Thematic Analysis. In *Applied Thematic Analysis*. <https://doi.org/10.4135/9781483384436>
- Hossain, M., Leminen, S., & Westerlund, M. (2019). A systematic review of living lab literature. *Journal of Cleaner Production*, 213, 976–988. <https://doi.org/10.1016/J.JCLEPRO.2018.12.257>
- INE. (2021). *CENSUS 2021 - Preliminary Results*. https://www.ine.pt/xportal/xmain?xpid=INE&xpgid=ine_indicadores&indOcorrCod=0011304&contexto=bd&selTab=tab2&xlang=pt
- INE. (2022). *RETORNO DE INFORMAÇÃO AOS RESPONDENTES MUNICÍPIOS*. www.ine.pt
- J. Schumacher, & K. Feurstein. (2007). Living Labs - the user as co-creator . *2007 IEEE International Technology Management Conference (ICE)*, 1–6. <https://ieeexplore.ieee.org/document/7458680>
- Kareborn, B. B., & Stahlbrost, A. (2009). Living Lab: an open and citizen-centric approach for innovation. *International Journal of Innovation and Regional Development*, 1(4), 356. <https://doi.org/10.1504/IJIRD.2009.022727>
- Leminen, S., Westerlund, M., & Nyström, A.-G. (2012). Living Labs as Open-Innovation Networks. *Technology Innovation Management Review*, 2(9), 6–11. <https://doi.org/10.22215/TIMREVIEW/602>
- Mahmoud, I. H., Morello, E., Ludlow, D., & Salvia, G. (2021). Co-creation Pathways to Inform Shared Governance of Urban Living Labs in Practice: Lessons From Three European Projects. *Frontiers in Sustainable Cities*, 3. <https://doi.org/10.3389/frsc.2021.690458>
- Maia Municipality. (2016). *Plano de Ação para a Regeneração Urbana (PARU)*.
- Maia Municipality. (2018). *BaZe - Living Lab Maia Implimentation Plan (unpublished internal document)*.
- Maia Municipality. (2020). *Green roof of the Forum da Maia*. <http://baze.cm-maia.pt/BaZe/cverde3.ht>
- Maia Municipality. (2021). *Review of the Sustainable Urban Mobility Plan of Maia, Unpublished internal document*.
- Maia Municipality & AdEPorto. (2020). *PLANO DE AÇÃO PARA A ENERGIA SUSTENTÁVEL DA MAIA 2030*.
- Margherita, E. G., Esposito, G., Escobar, S. D., & Crutzen, N. (n.d.). *Exploring the Smart City Adoption Process: Evidence from the Belgian urban context*.

- Marvin, S., Bulkeley, H., Mai, L., McCormick, K., & Palgan, Y. V. (2018). Urban living labs: Experimenting with city futures. In *Urban Living Labs: Experimenting with City Futures*. <https://doi.org/10.4324/9781315230641>
- Masseck, T. (2017). Living Labs in Architecture as Innovation Arenas within Higher Education Institutions. *Energy Procedia*, 115. <https://doi.org/10.1016/j.egypro.2017.05.035>
- Mats Eriksson, & Seija Kulkki. (2005). *State of the art in Utilizing Living Labs Approach to User-centric ICT Innovation - A European Approach*. https://www.researchgate.net/publication/228352439_State-of-the-art_in_Utilizing_Living_Labs_Approach_to_User-centric_ICT_Innovation_-_A_European_Approach
- Mccormick, K., & Hartmann, C. (2017). *The Emerging Landscape of Urban Living Labs: Characteristics, Practices and Examples*. Lund University. <https://portal.research.lu.se/en/publications/the-emerging-landscape-of-urban-living-labs-characteristics-pract>
- Merriam, S. B. (2009). *Qualitative Research: A Guide to Design and Implementation (JOSSEY-BASS HIGHER & ADULT EDUCATION SERIES)*. Jossey-Bass. https://books.google.com/books/about/Qualitative_Research.html?id=tvFICrgcuSIC
- Mills, A., Durepos, G., & Wiebe, E. (2012). Encyclopedia of Case Study Research. *Encyclopedia of Case Study Research*. <https://doi.org/10.4135/9781412957397>
- Moulaert, F., Martinelli, F., Swyngedouw, E., & González, S. (2005). Towards alternative model(s) of local innovation. *Urban Studies*, 42(11), 1969–1990. <https://doi.org/10.1080/00420980500279893>
- Mulder, I., & Stappers, P. J. (2016). Co-creating in practice: Results and challenges. *2009 IEEE International Technology Management Conference, ICE 2009*. <https://doi.org/10.1109/ITMC.2009.7461369>
- Nesti, G. (2017). Living Labs: A new tool for co-production? *Smart and Sustainable Planning for Cities and Regions*, 267–281. https://doi.org/10.1007/978-3-319-44899-2_16
- Nesti, G. (2018). Co-production for innovation: The urban living lab experience*. *Policy and Society*, 37(3), 310–325. <https://doi.org/10.1080/14494035.2017.1374692>
- Nevens, F., Frantzeskaki, N., Gorissen, L., & Loorbach, D. (2013). Urban Transition Labs: Co-creating transformative action for sustainable cities. *Journal of Cleaner Production*, 50. <https://doi.org/10.1016/j.jclepro.2012.12.001>
- Nu'Man, J., King, W., Bhalakia, A., & Criss, S. (2007). A framework for building organizational capacity integrating planning, monitoring, and evaluation. *Journal of Public Health Management and Practice*, 13(SUPPL.). <https://doi.org/10.1097/00124784-200701001-00006>
- Potter, C., & Brough, R. (2004). Systemic capacity building: A hierarchy of needs. *Health Policy and Planning*, 19(5), 336–345. <https://doi.org/10.1093/HEAPOL/CZH038>

- Puttick, R. , Colligan, P. , & Baeck, P. (2023). I-teams: The teams, units, and funds transforming governments around the world. In *Nesta and Bloomberg Philanthropies*. <https://www.nesta.org.uk/report/i-teams-the-teams-and-funds-making-innovation-happen-in-governments-around-the-world/>
- R. Katzy, B., & Bücken, C. (2015). The Organization of Living Labs: Coordinating Activities for Regional Innovation. *Technology Innovation Management Review*, 5(9). <https://doi.org/10.22215/timreview927>
- Radecki, Alanus. (2013). *The Morgenstadt Framework*. https://www.researchgate.net/publication/283319948_The_Morgenstadt_Framework
- Reckien, D., Flacke, J., Dawson, R. J., Heidrich, O., Olazabal, M., Foley, A., Hamann, J. J. P., Orru, H., Salvia, M., de Gregorio Hurtado, S., Geneletti, D., & Pietrapertosa, F. (2014). Climate change response in Europe: What's the reality? Analysis of adaptation and mitigation plans from 200 urban areas in 11 countries. *Climatic Change*, 122(1–2), 331–340. <https://doi.org/10.1007/S10584-013-0989-8/TABLES/1>
- Reorganização administrativa do território das freguesias: Annex I. Law no. 11-A/2013.* (2013).
- Saunders, C. H., Sierpe, A., von Plessen, C., Kennedy, A. M., Leviton, L. C., Bernstein, S. L., Goldwag, J., King, J. R., Marx, C. M., Pogue, J. A., Saunders, R. K., Van Citters, A., Yen, R. W., Elwyn, G., & Leyenaar, J. K. (2023). Practical thematic analysis: a guide for multidisciplinary health services research teams engaging in qualitative analysis. *BMJ*, e074256. <https://doi.org/10.1136/bmj-2022-074256>
- Schliwa, G. (2013). Exploring Living Labs through Transition Management - Challenges and Opportunities for Sustainable Urban Transitions. *IIIIEE Master Thesis, September*.
- Schneidewind, U., Augenstein, K., Stelzer, F., & Wanner, M. (2018). Structure matters: Real-world laboratories as a new type of large-scale research infrastructure: A framework inspired by Giddens' structuration theory. In *GAIA - Ecological Perspectives for Science and Society* (Vol. 27, pp. 12–17). Oekom Verlag. <https://doi.org/10.14512/gaia.27.s1.5>
- Scholl, H. J., & AlAwadhi, S. (2016). Smart governance as key to multi-jurisdictional smart city initiatives: The case of the eCityGov Alliance. *Social Science Information*, 55(2), 255–277. <https://doi.org/10.1177/0539018416629230>
- Schuurman, D., De Marez, L., & Ballon, P. (2013). Open Innovation Processes in Living Lab Innovation Systems: Insights from the LeYLab. *Technology Innovation Management Review*, 3(11). <https://doi.org/10.22215/timreview743>
- Schuurman, D., De Marez, L., & Ballon, P. (2018). *Living Labs: a systematic literature review*. <http://scholar.google.be/>
- SPACRS D4.3. (2022). *D4.3 Implemented demonstrations of solutions for energy positive blocks in Leipzig*.
- SPARCS. (2022). *D7.3 Governance Models for Sustainable Smart City Business Ecosystems*.
- SPARCS. (2023). *D4.6 Citizens and stakeholders in Leipzig's energy transition*.
- SPARCS. CMM, S. N. A. F. (2022). *SPARCS: D5.5. Implementation Plan Maia*.

- SPARCS, D. 1. (2020). *D2.1 Definition of SPARCS Holistic Impact Assessment Methodology and Key Performance Indicators*.
- Ståhlbröst, A., & Holst, M. (2012). *The Living Lab Methodology Handbook*. Luleå University of Technology and CDT – Centre for Distance-Spanning Technology, 76. http://www.ltu.se/cms_fs/1.101555!/file/LivingLabsMethodologyBook_web.pdf
- Tellioğlu, H., Habiger, M., Wagner, M., & Mikusch, G. (2019). Living labs reconsidered for community building and maintenance. *ACM International Conference Proceeding Series*. <https://doi.org/10.1145/3328320.3328407>
- Triangulum, D. 8. (2020). *Smart City Implementation Strategy Leipzig*.
- UNEP. (2015). *A Guide for Sustainable Urban Development in the 21st Century*.
- Veeckman, C., Schuurman, D., Leminen, S., & Westerlund, M. (2013). Linking Living Lab Characteristics and Their Outcomes: Towards a Conceptual Framework. *Technology Innovation Management Review*, 3(12), 6–15. <https://doi.org/10.22215/TIMREVIEW748>
- Vidal, D. G., Maia, R. L., Oliveira, G. M., Pontes, M., & Barreira, E. (2019). Cities challenges in the contemporary societies: Urban sustainability and environmental issues. *SOCIOLOGIA ON LINE*, 20, 119–138. <https://doi.org/10.30553/SOCIOLOGIAONLINE.2019.20.6>
- Voytenko, Y., McCormick, K., Evans, J., & Schliwa, G. (2016). Urban living labs for sustainability and low carbon cities in Europe: Towards a research agenda. *Journal of Cleaner Production*, 123, 45–54. <https://doi.org/10.1016/j.jclepro.2015.08.053>
- Weld, D. S. (1988). Comparative analysis. *Artificial Intelligence*, 36(3). [https://doi.org/10.1016/0004-3702\(88\)90086-0](https://doi.org/10.1016/0004-3702(88)90086-0)
- Whetten, D. A. (2009). Organizational comparative analysis: Investigating similarities and differences among organizations. *Research in the Sociology of Organizations*, 26. [https://doi.org/10.1108/S0733-558X\(2009\)0000026005](https://doi.org/10.1108/S0733-558X(2009)0000026005)
- Willems, J. J., Kuitert, L., & Van Buuren, A. (2022). Policy integration in urban living labs: Delivering multi-functional blue-green infrastructure in Antwerp, Dordrecht, and Gothenburg. *Environmental Policy and Governance*. <https://doi.org/10.1002/EET.2028>
- Willi Wendt, Marielisa Padilla, Nora Fanderl, & Tom HaWxWell. (2016). *City Lab Lisbon - Executive Summary*.
- Yin, R. K. (2018). Case Study Research and applications, 6th edition. *Paper Knowledge . Toward a Media History of Documents*, 414.

ANNEXES

Interview with Leipzig Municipality

Date and Time: 17.08.2023. 15.00 CET (45 Minutes through Zoom)

Interviewer: Minoo Mohammadkhorshidoost

Interviewee: Nadja Riedel, Senior Project Manager, Municipality of Leipzig

Introduction

Dear Nadja, thank you very much for taking the time and contributing to my thesis with your valuable experience and knowledge. I entered the SPARCS project as part of my internship with SPI for University of Padova and decided to extend my work as my master thesis and also give visibility to SPARCS project through my thesis work as SPI contribution to the project.

My thesis is mainly focusing on three topics of Urban Living Labs, Sustainability Transformation and Organizational Capacity Building. My goal is to find an answer to this question: “What factors increase the effective implementation of living lab-driven technological solutions in an urban context and what are the most challenging barriers to achieving this goal?”. Simply, I want to learn from your experience how organizations can increase their capacity to adapt to smart city initiatives and projects that aim to transform the cities into a more sustainable environments by implementing Urban Living Labs within their organizational structure.

Therefore, I need to know if the projects that you are working are efficient and aiming at correct problems and are following the best approaches? How effective are the replication plans? How the municipality efforts are responsive to the increasing demands and needs for transformations? How the knowledge sharing helps to build capacity inside the organization? What are the barriers that make it challenging to achieve these goals? How can Maia take the most from your experience in their implementation plan?

Following interview questions would help me understand and answer my research question and identify the potential gaps for future projects/research. Your contributions in any form to these questions would be highly appreciated.

Thank you once again for your collaboration.

1. As a Lighthouse City in the SPARCS project, what specific measures has Leipzig implemented to become more sustainable and energy-efficient?

Leipzig has implemented various measures to become more sustainable and energy-efficient, including the construction and integration of a solar thermal plant in the central district heating system, research to increase the share of renewable energies in the district heating network, assessing waste heat potential, integration of storage solutions, and optimizing the energy flow in a local micro network. Additionally, the project covers various low-carbon improvements in urban development, including buildings, energy systems, and the use of e-mobility measures and citizen engagement initiatives.

2. How has the collaboration with Maia Municipality and other project partners in the SPARCS project facilitated the exchange of knowledge and best practices? Can you provide examples of successful collaborations?

While the ongoing COVID-19 restrictions impacted the extent of interactions, there were instances of fruitful collaboration that contributed to knowledge dissemination.

Despite these challenges, noteworthy collaborations were evident. Notably, during the on-site visits in September and October. These visits, where fellows from diverse cities gathered in Leipzig and Espoo, respectively, facilitated in-depth presentations and discussions among local partners.

There is a stronger knowledge exchange among fellow cities, however, the interaction between cities like Maia and Leipzig was not very easy due to geographic distance. The physical distance posed certain constraints, but online monthly calls and meetings facilitated a not very strong knowledge exchange between Maia and Leipzig.

3. How has the Morgenstadt methodology and assessment framework influenced Leipzig's approach to sustainable urban development?

Leipzig's engagement with the Morgenstadt methodology began during the Triangulum project and continued through the SPARCS project. The methodology involves a comprehensive approach, encompassing interviews, scoring, and action field identification. However, since the city is already in an advanced level of sustainability monitoring, the methodology didn't provide any added value to the project in a fully fetched manner. Applicability and influence of the Morgenstadt methodology depend on the city's context

and its existing frameworks. Cities such as Maia in their first stages of sustainability transition can adapt this methodology to benefit from a simplistic approach as a start.

4. What challenges did Leipzig Municipality encounter during the implementation of sustainability initiatives, and how were they overcome?

One significant challenge highlighted was the disruption caused by the COVID-19 pandemic. The pandemic's restrictions hindered physical interactions and on-site visits among project partners, which impacted knowledge exchange and collaborative efforts. To address this, Leipzig leveraged digital platforms and virtual meetings to maintain communication and collaboration, albeit in a modified format.

Additionally, sustaining project momentum after the conclusion of funding periods was a common challenge. Leipzig faced the prospect of potential staff reductions due to the conclusion of the SPARCS project and another project the following year. This situation prompted the municipality to seek municipal funding or secure new projects to retain skilled personnel and maintain continuity.

Furthermore, Leipzig faced challenges related to internal structures and capacities. While the city had already established a Smart City unit, a portion of its team was project-funded rather than municipally financed. This raised concerns about maintaining the current staff size and expertise. To overcome this, the city explored various avenues, including seeking external project funding and municipal budget allocation.

5. How do you see the future of sustainable urban development in Leipzig and the potential for replicating the city's initiatives in other contexts?

Leipzig's experiences and methodologies present valuable lessons for other contexts. The collaborative spirit and partnerships forged with public utilities, companies, and research institutions also offer valuable replication models. Leipzig's practice of networking and bringing stakeholders together enabled the establishment of consortia and the development of successful project proposals. This collaborative approach is transferable to other cities seeking to engage various stakeholders to drive sustainable urban development.

Furthermore, Leipzig's ability to adapt to challenges, like the pandemic, through virtual interactions underscores its resilience and agility. These experiences can be shared as best

practices, aiding other cities facing similar obstacles in knowledge exchange and collaboration.

6. How have you assessed the existing capacity and identified the specific needs within the organizations to establish the smart city unit? What methodologies or approaches have been utilized?

The establishment of Leipzig's Smart City unit involved a comprehensive assessment of existing capacities and the identification of specific needs within the organization. This process was driven by methodologies and approaches that ensured a well-informed and strategic formation of the unit. The establishment of the Smart City unit started with networking and collaboration. Through engagement with various stakeholders, including public utilities, companies, and research institutions, Leipzig fostered a collective understanding of the city's potential in the realm of smart city initiatives. This networking approach provided a foundation for assessing existing capacities and gauging the level of expertise within different entities.

Furthermore, the establishment of the Smart City unit was supported by leveraging project funding.

7. What are the most important lessons you have learned from this process?

Networking and Collaboration are Vital: Building strong networks and collaborations with stakeholders, including public utilities, companies, and research institutions, played a crucial role in forming a collective understanding of the city's potential. Engaging diverse partners enhances knowledge exchange and lays the foundation for successful initiatives.

Adaptability in Challenging Times: The COVID-19 pandemic highlighted the importance of adaptability. Utilizing digital platforms and virtual meetings allowed the city to maintain communication and collaboration despite external disruptions. Flexibility in the face of challenges is essential for sustaining progress.

Proactive Resource Allocation: Leipzig's approach of utilizing project-financed personnel for initiating the Smart City unit showcased the importance of proactive resource allocation. Allocating resources strategically and taking advantage of available funding sources enables the testing of ideas and building expertise.

Holistic Assessment Frameworks Provide Insights: The use of holistic assessment frameworks, such as the Morgenstadt methodology, can provide valuable insights into a city's strengths, weaknesses, and areas for improvement. While not prescriptive, these frameworks guide strategic planning and help identify necessary actions.

Focus on Internal Capacities: The challenge of maintaining internal capacities post-funding underscores the need to explore various avenues, including municipal budget allocation, to secure skilled personnel. A well-established team is vital for continuity and successful project execution.

Lessons from Collaborative Initiatives: Successful collaborations with partner cities, both physical and virtual, emphasized the importance of city forums, on-site visits, and knowledge exchange. These interactions foster deeper understanding and shared learning.

Context Matters for Methodology Application: While methodologies like the Morgenstadt framework provide structured approaches, their application should consider the city's specific context and existing frameworks. Aligning methodologies with local needs enhances their effectiveness.

Long-Term Vision and Sustainability: Ensuring the long-term sustainability of initiatives requires a proactive approach, including seeking additional funding sources and integrating sustainability measures into urban development concepts. Vision, coupled with proactive planning, drives lasting impact.

Interview with External Stakeholder

Date and Time: 17.08.2023. 15.00 CET (45 Minutes through Zoom)

Interviewer: Minoo Mohammadkhorshidoost

Interviewee: Joao Medina, Senior Project Manager, SPI

Introduction

In the pursuit of understanding the intricacies of sustainable urban development and collaborative initiatives, I have the privilege of engaging in an insightful conversation with Joao Medina who possesses extensive experience and in-depth insights into the workings of the Municipality of Maia. This interview serves as a valuable opportunity to tap into the wealth of knowledge that has been garnered through years of active involvement with Maia's endeavours in the realm of sustainable urban development.

Throughout this conversation, we aim to explore the challenges encountered by Maia in implementing sustainable urban development projects, particularly within collaborative projects. By delving into their expertise, we hope to uncover the nuanced factors that have propelled Maia's successes and the strategic approaches that have been instrumental in overcoming obstacles.

Our discussion will explore the complicated dynamics of capacity building within the municipality, shedding light on the strategies and practices that have enhanced Maia's organizational readiness for embracing innovative sustainability measures.

- 1. Can you provide an overview of your experience working with the Municipality of Maia in the context of sustainable urban development projects? What roles or positions have you held that have contributed to your understanding of the municipality's efforts in this area?**

my experience with the Municipality of Maia spans several significant roles and capacities within the realm of sustainable urban development projects. These roles have provided me with a comprehensive understanding of the municipality's efforts in this domain. Initially, I was involved in traditional urban development projects that encompassed aspects such as land use, urban renewal, architecture, and mobility across various locations within Maia. This allowed me to grasp the fundamental challenges and opportunities in shaping urban spaces.

Subsequently, I assumed a pivotal position in the strategy for Maia's Smart City initiative. Managing projects aimed at enhancing the municipality's capabilities in smart city development, I delved into domains that extended far beyond mere digital transformation, encompassing diverse facets of sustainable urban growth. Additionally, my involvement in European projects focusing on energy issues further deepened my insights. Collaborating on projects like SPARCS emphasized the significance of sustainable energy actions within a broader urban development context. These collective experiences have uniquely positioned me to comprehend Maia's intricate journey in striving for sustainable urban development.

2. From your experience, what are some of the key challenges and limitations that the Municipality of Maia has encountered in implementing sustainable urban development projects, especially within collaborative smart city initiatives?

In my interactions with the Municipality of Maia, I've observed several noteworthy challenges and limitations that have surfaced during the implementation of sustainable urban development projects, particularly within collaborative smart city initiatives. One of the primary difficulties lies in the organizational structure and the way information is compartmentalized. This siloed approach results in duplicated efforts, missed synergies, and inefficiencies. Moreover, the inclination to view smart city initiatives primarily through the lens of digital transformation and information technologies poses a substantial challenge. This narrow perspective often overlooks the broader urban transformation encompassing behaviour changes, environmental sustainability, and societal improvements. Additionally, the reliance on a small dedicated team for managing such projects can lead to disparities in engagement. The challenge is to transcend this small group's involvement and engage a wider array of departments and stakeholders across the municipality. Furthermore, funding constraints and dependency on external financing sources, both at national and international levels, hinder the municipality's agility to undertake projects on its terms. These challenges collectively reflect the complex landscape of implementing sustainable urban projects and underline the need for more inclusive and multifaceted strategies.

3. In your view, what factors have contributed to the successes that the Municipality of Maia has achieved in the realm of sustainable urban development? Can you highlight any specific strategies or practices that have been particularly effective?

In assessing the successes of the Municipality of Maia in the domain of sustainable urban development, certain factors have emerged as influential. Firstly, the presence of an internal

team with a focused understanding of the subject matter has been pivotal. This team, despite its limited size, has displayed a keen awareness of the nuances of sustainable urban development. Moreover, their consistent search for partnerships and opportunities has yielded positive outcomes, contributing to the municipality's engagement in relevant projects. Additionally, the ability to mobilize resources, both in terms of consultants and internal expertise, has been crucial in driving successful implementations. Furthermore, the municipality's readiness to participate in European projects and its proactive approach in seeking financing sources have been significant contributors to its achievements. A noteworthy example is the creation of Maya Ambiente, a company within the municipality, which independently addresses environmental issues, showcasing their innovative mindset. These factors collectively underscore the municipality's dedication, strategic foresight, and capacity to navigate a challenging landscape.

4. The BaZe project aims to develop, implement, and test innovative solutions for decarbonization. Based on your experience, what have been the most significant barriers to implementing such living lab-driven technological solutions within the municipality? How have these barriers been addressed?

When considering the BaZe project's pursuit of innovative solutions for decarbonization within the Municipality of Maia, several significant barriers have come to light. One notable challenge has been the organization's internal structure, characterized by silos of information and fragmented departments. This compartmentalization often leads to overlaps and duplications of efforts, hindering the seamless integration of sustainable solutions. Another pronounced issue lies in the perception of smart city projects, which tends to be narrowly equated with digital transformation. This narrow view has led to misunderstandings and limited engagement across various departments, impeding a holistic approach to sustainable urban development. Moreover, the scale of the solutions being implemented, while commendable, often remains relatively small in the face of larger systemic challenges. Despite these barriers, the municipality's ability to mobilize consultants and external partners for pilot projects has addressed certain challenges. However, broader engagement across departments and a more comprehensive understanding of sustainable urban development are crucial aspects that require further attention to address these barriers effectively.

5. Capacity building is a crucial aspect of organizational development. Could you provide insights into the strategies that the Municipality of Maia has employed to

enhance its capacity for sustainable urban development and collaborative initiatives? Have there been any specific challenges in this regard?

Certainly, capacity building holds significant importance for organizational growth, especially in the context of sustainable urban development. In the case of the Municipality of Maia, they have taken steps to reinforce their internal team's expertise in this domain. This team, with a specific focus on smart city initiatives, actively seeks out opportunities and partnerships to further their knowledge. However, despite these efforts, challenges persist. The municipality's structure remains somewhat rigid, with a significant reliance on funding applications for project execution. This dependence on external financing can impact the scale and scope of their initiatives. Additionally, while the internal team shows expertise, the broader organizational culture may not uniformly recognize the broader importance of sustainable urban development projects. This can hinder collaboration across departments and diminish the overall effectiveness of capacity-building strategies. Finding ways to bridge these gaps and foster a more comprehensive understanding and engagement across the municipality's structure is key to overcoming these challenges and enhancing capacity further.

6. Based on your interactions with the Municipality of Maia, how would you assess its level of readiness and engagement in terms of adapting to new regulations, technologies, and innovative sustainability measures? Are there specific areas that require further attention?

From my interactions with the Municipality of Maia, I would assess its level of readiness and engagement as quite high compared to many other municipalities. In terms of adapting to new regulations, technologies, and innovative sustainability measures, Maia has shown a proactive approach. They have an internal team dedicated to exploring opportunities and partnerships in these areas. However, there are certain aspects that warrant attention. One significant challenge is the tendency to perceive sustainable urban development mainly through the lens of digital transformation. This digital-centric mindset can limit the broader understanding of the multidimensional nature of sustainability initiatives. To enhance readiness and engagement, it's crucial to distinguish between technology-driven projects and comprehensive urban development strategies. Additionally, while the internal team is quite adept, creating mechanisms for cross-departmental involvement and understanding is essential. This would ensure that sustainability measures are seen as a priority by all segments of the municipality, not just a specialized team. By addressing these aspects, Maia can further strengthen its

readiness to adapt to evolving regulations and technologies and successfully implement innovative sustainability measures.

7. Looking into the future, what recommendations would you offer to the Municipality of Maia to further enhance its efforts in sustainable urban development and collaborative projects? Are there any emerging trends or areas that you believe warrant greater attention?

Considering the future, I would offer a few recommendations to the Municipality of Maia to further enhance its actions in sustainable urban development and collaborative projects. Firstly, it's crucial to separate the concepts of sustainable development from digital transformation in the minds of stakeholders. Clear communication and education are necessary to ensure that sustainability initiatives are not solely seen as technological activities. Secondly, internal procedures should be streamlined to facilitate cross-departmental interactions. Allocating a portion of the time of various workers, not just a specialized team, to engage in sustainable urban development projects can foster a more comprehensive and integrated approach. This would help in breaking down silos and fostering collaboration across different sectors. Lastly, staying updated with international trends and best practices is essential. Maia should consistently explore successful models and experiences from other cities to adapt and implement relevant strategies. Additionally, emerging areas like circular economy, nature-based solutions, and resilience should receive greater attention in Maia's sustainability agenda. By incorporating these recommendations, the Municipality of Maia can continue to excel in sustainable urban development and effectively contribute to collaborative projects in the long run.