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Empower collaboration by developing KAMK Living Labs to connect students and companies.

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Abstract

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Living labs (LLs) are collaborative environments where academia, industry, and public sector entities join forces to innovate and research in real-life contexts. These environments allow testing, validating, and co-creating new products and services, bridging the gap between theory and practice. By fostering collaboration among different actors, LLs address the "European paradox" by translating research into market-ready solutions more effectively, promoting regional innovation, and driving economic growth. Universities, with their diverse expertise and interdisciplinary approach, play a key role in hosting LLs, facilitating cross-disciplinary collaboration and innovation, and accessing a wide network of students, researchers, and industry partners, which are the ideal settings for LL initiatives. By developing LLs within universities like Kajaani University of Applied Sciences (KAMK), institutions leverage academic resources to drive innovation and regional development.

This thesis aims to deepen the understanding of LLs, assess the alignment of KAMK RDI activities with LL principles, provide best practices from European HEIs with LLs, and ultimately optimize KAMK's LL operations. The purpose is to identify how KAMK can strategically leverage an improved LL model to enhance its RDI initiatives, emphasizing the role of HEIs in regional innovation ecosystems and the systemic changes LLs can bring, particularly in peripheral areas. This study is part of the ENIHEI project. The commissioner of this thesis is KAMK institution, and the research employed a case study approach, in which interviews were conducted with the institution's R&D team members to assess their current status, coupled with qualitative benchmarking with three HEIs from Italy, Bulgaria, and Sweden, all part of the ENIHEI project. Data was analyzed using abductive methods. Findings identified key areas for improvement, including interdisciplinary collaboration, harmonization within teams, student engagement, and knowledge sharing.

The study led to the development of an enhanced LL model aimed at improving operational efficiency, collaboration dynamics, and student involvement within KAMK's ecosystem. This research contributes to optimizing KAMK's LL framework, and the proposed model may serve as a reference for other institutions seeking to bolster their research and development capabilities through collaborative and student-centric approaches.

Preface

"*No power and no treasure can outweigh the extension of our knowledge*". – Democritus.

This thesis reflects my dedication to exploring innovation and living labs and my commitment to contribute to this ever-evolving field. It is the result of countless hours of diligent work and collaboration.

I am immensely grateful to my supervisors, Päivi and Mikko, for their insightful guidance and support throughout this journey. A warm thank you to all informants, whose insights greatly enriched this research.

Most importantly, I want to thank my family for their steadfast love and encouragement. This thesis is dedicated to my dad, whose wisdom and influence have always been a guiding force in my life.

I hope that this work adds meaningful insights to the fields of Living Labs and KAMK and serves as a foundation for future research. Thank you for your interest in this thesis, and I hope you find value in the discoveries shared within these pages.

Sincerely,

X Carolina Ferreira

Carolina Ferreira

Table of Contents

List of Figures

List of Symbols

LL – Living Lab

KAMK – Kajaani University of Applied Sciences

EU – European Union

ENIHEI- European Network of Innovative Higher Edu3333cation Institutions

HEI – Higher Education Institution

RDI – Research, Development, and Innovation

THM – Tripple Helix Model

QHM – Quadruple Helix Model

PPP - Public-private partnerships

1 Introduction

1.1 Research Context

Globalization and digitalization have accelerated industry development and integration. In response to the dynamic operational landscapes and intensifying competition, innovation has become essential for businesses to endure and secure their sustainability (Gawarzynska, 2010, p.9). European societies are currently confronted with a range of pressing issues that significantly impact its common future, including aging and demographic changes, increased competitiveness, and most importantly, the need to boost overall productivity and innovation, within a challenging and time-constrained environment (Eriksson et al., 2005, p.1). Addressing such challenges calls for novel approaches to structure innovation endeavours and identify supplementary opportunities for driving innovations.

Evolving at such an unpredictable pace, innovation is compelled by the diffusion of knowledge and technological advancements, and as a result, it stands as a catalyst of societal advancement, economic growth, and sustainability. This evolution has led to a departure from traditional approaches, where isolated experimentation and frequent detachment between innovators and end-users results in solutions that do not fully address real-world needs and user requirements. Hence, tapping into the potential of users has transformed the traditional innovation process, enabling a more user-centric and inclusive approach, in which results of innovations that better meet real-world needs, have higher adoption rates, and have a positive societal and economic impact (Bergvall-Kåreborn et al., 2009).

Traditionally, Europe excelled in research but underperformed in achieving commercial success in the marketplace, a phenomenon referred to as the “European paradox”, thus European policy initiatives have been initiated, to narrow the breach between knowledge production, transfer, and the successful commercialization of innovations (Dutilleul et al., 2010, pp. 63–66). This led to the emergence of Living Labs (LLs), as an innovative response to bridge the gap between academia, industry, and society, and generate more relevant and user-centric solutions by actively involving end-users in the innovation process (Schuurman, 2015, p.8).

In today’s rapidly changing society, these LLs become more needed as they address complex societal challenges that necessitate professionals to continually revise their skills and cooperate across various fields. Traditional higher education may fall short in training students for such

challenges, potentially colliding with the demands of professional practices. LLs present an opportunity for higher education institutions (HEIs) to actively engage with practical professional environments, concentrating on research and innovation in real-life settings while companies gain access to a pool of talent, with new perspectives and cutting-edge ideas (van den Heuvel et al., 2021, p.30).

KAMK, the commissioning institution, is committed to nurturing the intellectual ability of its students whilst promoting economic growth in the Kainuu region. By integrating LL principles into its RDI teams, the institution provides an opportunity for this Higher Education Institution (HEI) to engage in practical research, innovation, and collaboration with companies. This approach generates a dynamic ecosystem where students, faculty, and companies collaborate towards creating impactful solutions and tackling regional issues, particularly in peripheral areas with pressing issues such as the aging population and the lack of skilled workers.

The objective is to enhance academic learning as well as drive the economic development of the region, understanding the importance of training students for the demands of the contemporary workforce. Additionally, the institution actively participates in the European Network of Innovative Higher Education Institutions (ENIHEI) network's working group one, which promotes the potential of higher education in catalyzing innovation through innovative thinking and places a strong emphasis on nurturing creativity and facilitating knowledge exchange among network partners (the HEIs) through LLs (KAMK, n.d.-b).

KAMK is renowned for its RDI activities, conducted to enhance customers' products, services, and processes, while performing demand-driven applied research, supported by highly trained staff, established networks to local and national working environments, and effective project management (KAMK, n.d.). Nevertheless, the institution's RDI teams face challenges related to the research problem. They often operate like silos with limited internal knowledge sharing and disconnection between researchers and project members. In addition, a lack of common established guidelines or best practices to standardize research processes is observed, contributing to a lack of open collaboration among researchers, which might hinder the cross-pollination of ideas essential for the quality and efficiency of research outcomes.

In light of this, there is significant interest in further developing and enhancing the LLs' principles and initiatives within KAMK' RDI teams, as they represent dynamic hubs for research and innovation. This thesis aims to deepen the understanding of the concept of LL, examine the alignment of RDI teams' activities within LLs with established principles, provide best practices from the

extended network of collaborating European HEIs with established LLs, investigate development and enhancement strategies for optimizing KAMK' labs and provide recommendations. The goal is to boost the use of LLs more effectively to promote collaborative research and innovation in KAMK and contribute to the increasing knowledge of the role of LLs in promoting a sustainable future and driving positive change.

The purpose of this research is to identify how KAMK can strategically leverage an LL model to develop and enhance the effectiveness of the RDI initiatives of the studied HEI. By recognizing the critical role of HEIs within regional innovation ecosystems (KAMK, n.d.-b), the research sheds light on the systemic change LLs can bring, particularly in peripheral areas. This is achieved by leveraging the collective knowledge of partner institutions to improve open innovation, knowledge sharing, and collaboration within the university's ecosystem and with external partners.

This thesis aims to address the following questions:

> **Q1:** To what extent do KAMK's current RDI labs align with overall established LL principles?
>
> **Q2:** Which key points should KAMK and its ecosystem prioritize to strategically develop and enhance its LLs?
>
> **Q3**: What recommendations can be proposed to optimize the development of KAMK's LLs to tighten the collaboration, boost innovation, and contribute to the economic development of the Kainuu region?

To answer these questions, this thesis adopts a case study research strategy, employing multiple qualitative data collection methods. Semi-structured interviews were conducted to five RDI teams' experts from the studied HEI and collaborative workshops were held with selected benchmarked HEIs from the ENIHEI project, designated as participants in this study. An abductive approach is employed to analyze the data. Based on the findings, a set of recommendations was developed through a co-creation process with the commissioner representative, incorporating the input from brainstorming sessions to enhance the development of their labs.

The justification for this study lies in the need to adapt to the changing educational landscape, aiming to bridge the gap between academic research and real-world innovation, enhance the LLs functionality and usefulness in this HEI and periphery regions to drive economic development,

with the intention to boost its competitive position, attract adept students, faculty and research partners, positioning KAMK as a dynamic hub for innovation in higher education.

1.2 Thesis Structure

This thesis is structured into eight distinct chapters, with the following sections that offer a summary of the content presented within each chapter.

(1) Introduction: This chapter provides the research's context, research problem, objectives, purpose, questions, and a brief glimpse of the content of the following chapters.

(2) Literature Review: Within this chapter, it is explored the theoretical framework and concepts connected and relevant to the research topic.

(3) Commissioner: Presentation of the commissioner and project.

(3) Research Design: This chapter describes the selected methods used to validate the research approach.

(4) *Empirical Methods:* This chapter explains the practical aspects of the research, describing the methods used for collecting data.

(4) Data Analysis and Findings: This chapter represents the research data, and methods of analysis, and reveals findings in alignment with the research aim and questions.

(5) Conclusion: This chapter presents the research conclusion based on the data analysis.

(6) Discussion and Recommendations: This chapter assesses and elaborates upon the findings, delves into key recommendations, and emphasizes the limitations faced throughout the research.

2 Literature Review

2.1 Innovation

Innovation is a complex and interdependent global phenomenon that involves the creation of value from knowledge, whether by introducing new or significantly improved products (goods, services, processes, or methods) to the market, finding new ways of production, or developing a market (Gault & Zhang, 2010, p. 14). Driven by the diffusion of knowledge and technological advancements, innovation acts as a catalyst for progress, societal advancement, economic growth, technological advancement, and sustainability on a global scale.

In simpler terms, it entails producing, integrating, and exploiting novelty in economic, social, and organizational contexts, by providing new solutions that meet the needs of individuals and societies. Different perspectives and types of innovation exist, each with a specialized group of individuals associated with it (Mercier-Laurent, 2011, p. 31).

Innovation has become a priority for various entities including the government, businesses, universities, and civil society, across the world. However, its landscape is being transformed due to broader changes happening in the world that are impacting economies and societies at large. Factors such as the internet, digitalization, globalization, urbanization, environmental concerns, demographic shifts, and economic growth slowdown, have impacted the direction and dynamics of innovation (OECD, 2015, p. 34).

As industries shift towards information and service-oriented environments (Mercier-Laurent, 2011), driven by globalization and evolving consumer expectations, the importance for businesses to embrace innovation has intensified, stressing the role of innovative thinking and practices (Gawarzynska, 2010, p. 9). In the EU, where an increase of specialization in industry sectors and complex products and solutions prevail, service innovation has gained significant importance. Such changes in innovation structures reflect the need for businesses to adapt and innovate in order to remain relevant (Eschenbächer et al., 2010, p. 15).

Innovation is not a linear process, but rather a complex and uncertain social process that requires collaboration among different actors and organizations (Kline & Rosenberg, 2009, p. 173). Combining scientific knowledge with practice-based learning is key to enhancing innovation performance (Kline & Rosenberg, 2009, p. 174). Nonetheless, managing innovation demands for

flexibility and creativity in organizational approaches whilst navigating uncertainties and complexities (Mercier-Laurent, 2011, p. 1). Additionally, it is imperative to implement an innovation culture, as not only aids in developing innovations but also optimizes existing processes and systems, resulting in better business outcomes.

In the context of the knowledge economy, innovation success depends on recognizing the interconnectedness of all process elements. It depends on the participants' imagination, collective intelligence, relevant knowledge, opportunity identification, and operation efficiency (Mercier-Laurent, 2011, p. 61).

Eschenbächer (2009) [as cited in (Eschenbächer et al., 2010, p. 17)] classified innovation as a novel form of a product, process, service, business model, technological, application, empirical, marketing, or structural. Moreover, innovation can be categorized into different types of innovation (Mercier-Laurent, 2011, p. 37), each with different dynamics and mechanisms for product, process and service creation, briefly explained below to provide the reader with a broader view of the innovation spectrum.

Innovation Type	Definition
Incremental	Improvement or creation of variants to existing products, services, or methods (most frequent).
Radical or disruptive	Offers a new technology, approach, product, or service that is either non-existent or creates new markets and uses.
Closed	Narrows innovation to internal resources, limiting it to R&D and potentially resulting in resource-intensive, unsuccessful products.
Participative	Involves various internal actors, including management and employees, in idea generation, requiring decentralization and facilitation.
Open	Involves collaboration with external partners, customers, and suppliers to exchange ideas, knowledge, and resources.
Collaborative	Involves various organizations joining forces to innovate together. Productive, yet can pose IP challenges if not addressed upfront.
Product / Service	Introduce new products or add novelty to existing ones / Create or improve services provided to customers.
Organizational	Employ new ideas or methods within an organization to improve performance and competitiveness.
Social	Generate and implement new solutions to address societal issues, aiming for positive social change through collaboration midst diverse stakeholders.
User-centered	Customer/ user engagement in the innovation process leads to products that improve job performance.
Global	Collaborative networks across countries, companies, universities, and organizations, generate value through shared knowledge and a collective vision.

Figure 1 Different types of innovation (Mercier-Laurent, 2011, pp. 38–56).

This research considers selected types of innovation, mostly related to the context of research, however, it is worth noting that there is a rich literature and numerous other types of innovation available. Within the research scope, different forms of innovation are implemented and evaluated within experimental innovation ecosystems, particularly in living labs, yet success depends on factors like lab design, stakeholder involvement, and contextual suitability.

For any type of innovation to thrive, the right combination of resources, actors, and supporting environment is necessary. It rarely happens in isolation (Kline & Rosenberg, 2009, p. 183) having instead, innovation systems and ecosystems at the heart of the innovation process. An innovation system consists of an interconnected network of organizations, institutions, and individuals, collaborating in creating, spread and utilizing new ideas and technologies. It encompasses government agencies, research institutions, businesses, startups, academia, and non-profit organizations, each contributing with their unique perspectives, resources, and expertise to the innovation process (Smorodinskaya et al., 2017).

Within such a system, innovation ecosystems emerge. Consists of dynamic environments and interconnected systems and networks where various stakeholders interact to generate joint value through development and commercialization processes (Adner, 2006, p.2). These ecosystems thrive in environments characterized by openness, diversity, and fluidity, where ideas can flow freely, and experimentation is encouraged, adopting a holistic approach to innovation.

The concept of innovation ecosystem has gained popularity across industry, academia, and government, having emerged in the early 2000s to meet the demands of emerging knowledge-based economies, where innovation production and development processes are increasingly non-linear and network-based (Smorodinskaya et al., 2017, p. 5245). But unlike traditional approaches, innovation ecosystems view innovation as a dynamic and flexible process, akin to a living ecosystem, rather than being regulated by governments, these ecosystems are self-governing, allowing for more interactive and collaborative innovation (Smorodinskaya et al., 2017, p. 5248).

Granstrand & Holgersson (2020, p. 3) describes it as dynamic network that involves cooperation among universities, research institutes, and businesses to drive creativity and progress. Involve a set of actors, activities and resources, interconnected through institutions and relationships frameworks, imperative for innovation. Tangible assets (e.g. funds and equipment) alongside intangible assets (knowledge, and expertise embodied in individuals such as students, faculty, and industry professionals) are key elements. Collectively, these components collaborate and

exchange ideas, driving innovation and advancements across different sectors (Granstrand & Holgersson, 2020, p. 8).

Such ecosystems range from local clusters to global networks, facilitating the cross-pollination of ideas, open collaboration, and connectivity among stakeholders, by providing a conducive environment for nurturing various types of innovation across the spectrum, fostering experimentation, and risk-taking while emphasizing resilience and adaptability for long-term sustainability (Smorodinskaya et al., 2017, p. 5248).

To succeed, it must have the ability to adapt to change and leverage collective strengths to address critical gaps in the innovation landscape, hiding on several key factors, including resources, governance, strategy and leadership, organizational culture, human resources management, people, partners, technology, and clustering (Durst & Poutanen, 2013). Building and sustaining such ecosystems can be complex due to diverse stakeholders, fragmentation and silos, and regulations that can hinder collaboration and knowledge-sharing and thus, strategies such as cross-sector collaboration, regulatory reforms, and open innovation are imperative to overcome such challenges. By promoting and developing strong innovation systems and ecosystems, societies can harness the potential of collective creativity to tackle critical issues and enhance the overall standard of living (Smorodinskaya et al., 2017, p. 5252).

In case of KAMK, the institution is an innovation system and an innovation ecosystem partner within Kainuu region, contributing to the region's innovation capacity through research activities, technological advancements and tailored educational programs to meet the needs of local industries. Also, acts as a catalyst for the development of the innovation by actively engaging with various stakeholders, including businesses, government agencies, and community organizations. Through initiatives such as LLs, entrepreneurship programs, and industry collaborations, the HEI fosters a collaborative environment that drive economic growth and societal development within the Kainuu region.

Durst & Poutanen (2013) connected innovation ecosystems to open innovation, as both rely on knowledge flows for co-creation and collaboration. Diverse ideas converge and thrive in these ecosystems, fostering the dynamic of living labs, which are a specific type of innovation ecosystem that prioritizes user-centered approaches and real-world experimentation.

2.2 Living Labs

2.2.1 Definition and Conceptualization

Since the implementation of the Lisbon strategy in 2000, European policy has been propelled by openness and innovation, particularly within the domain of ICT advancements focusing on the collaboration among diverse actors. This led to the rise of innovation intermediaries, Living Labs—a concept embodying open innovation through ICT-driven collaborative environments, user-centric product/service development methods, and public-private partnerships (PPP) (Eschenbächer et al., 2010, p. 24).

Considered an open innovation ecosystem, LLs employ user-centricity and a structured approach to involve users in the co-creation process, whether in physical locations or virtual settings. They enable the pooling of resources within a dynamic and participatory ecosystem, where tailored ideas and solutions are developed, and subject to rigorous testing, refinement, and implementation with real-time feedback from end-users (Leminen et al., 2012, p. 10).

By promoting direct engagement and participation of stakeholders, LLs facilitate a deeper understanding of user's challenges, aiding in the development of highly effective and impactful solutions and innovations that have the potential to revolutionize industries. Stakeholders form a public-private-people partnership (4Ps), involving organizations, universities, research institutions, solutions developers, local government bodies, policymakers, and user communities all collaborating on the creation process (Compagnucci et al., 2021, p. 5; Leminen et al., 2012, p. 10; European Commission, 2009, p. 7).

Scholars have pointed out LLs as entities that prioritize practical applications, nurturing open and collaborative innovation and functioning as authentic settings and arenas where user-driven innovation processes can be followed throughout every phase of design and commercialization (Almirall et al., 2012, p. 12; Leminen et al., 2012, p. 7; Schuurman & Tõnurist, 2017, p. 8). This allows for the creation of tangible and practical innovations by harnessing user and communities' input, enhancing market evaluation reliability, and helping companies and entrepreneurial endeavours to rapidly commercialize and upscale their innovations in real-life contexts (Veeckman et al., 2013, p. 4). In other words, it accelerates innovation development, whilst being a cost-effective approach due to access to diverse networks and funding sources that can support research and implementation.

Academic research into LLs has a historical trajectory of decades (Ballon & Schuurman, 2015). Within the current literature, the definitions and conceptualizations of LLs vary noticeably, mirroring the diverse viewpoints and dynamic characteristics of these innovation ecosystems. The concept emerged in academic discussions during the 1990s, yet the term "*Living Lab*" was introduced by Prof. William Mitchell at MIT in the early 2000s, representing a user-centred research approach for perceiving, prototyping, validating, and enhancing solutions within controlled experimental settings (Eriksson et al., 2005, p. 7). Evolvingly, due to advancements in technology, and societal and economic changes, the phenomenon of LL transitioned from controlled research settings to dynamic, user-centric, and multi-stakeholder innovation ecosystems (Ballon & Schuurman, 2015).

Currently, there is a variety of definitions that can be observed in the following matrix of definitions, according to multiple relevant actors across the domain of LLs, listed chronologically (Table 2).

LIVING LABS ARE…	"*Experimentation environment where technology is developed in real life contexts and (end) users are considered 'co-producers'"*	Ballon et al. (2005)
	"Research approach for sensing, prototyping, validating and refining complex solutions in real-life contexts"	Eriksson et al. (2005)
	"Platforms where users actively participate in the innovation process, participating in the development, testing, and validation of new ideas, technologies, or services."	Mulder et al. (2007)
	"Collaborations of public-private-civic partnerships where stakeholders co-create new products, services, businesses and technologies in real-life environments and virtual networks in multi-contextual spheres"	Feurstein et al. (2008)
	"An innovation intermediary community which shares the view of a user innovation approach" "Co-creation spaces where users, researchers, and companies…design, prototype, and evaluate innovations, leveraging real-world contexts and user feedback."	Ståhlbröst and Bergvall-Kåreborn (2008; 2009)
	"User-centered, open innovation ecosystems based on user co-creation approach, integrating research and innovation processes in real-life communities and settings."	European Commission (2009)
	"Improvement or implementation of public and user involvement, such as a public-private-people partnership"	Arnkil et al., (2010)
	"A social configuration which is arranged for innovation creation by contact, communication and collaboration"	Dutilleul et al. (2010)
	"A characteristic form of open innovation model…physical regions or virtual realities, or interaction spaces, in which stakeholders form public-private-people partnerships (4Ps) of companies, public agencies, universities, users, and other stakeholders, all collaborating in real-life contexts"	Westerlund and Leminen (2011)

	"Real-life environments where stakeholders co-create, test, and evaluate innovative ideas, products, or services, fostering user engagement and feedback."	Almirall and Wareham (2011)
	"Open innovation ecosystems that involve multiple stakeholders in co-creation, experimentation, and validation of new ideas, solutions, and technologies in real-life environments."	Leminen et al. (2012)
	"Real-life environments where stakeholders co-create, test, and evaluate innovative ideas, products, or services, fostering user engagement and feedback."	Almirall and Wareham (2012)
	"Represent a pragmatic approach to innovation…characterized by experimentation in real-life settings and active involvement of users"	Ballon and Schuurman (2015)
	"User-driven open innovation ecosystems, where users actively participate in the development, testing, and validation of new technologies, products, and services in real-world settings."	Schuurman et al. (2018)

Figure 2 Selected definitions of LLs.

The above conceptualizations share common characteristics, such as a user-centric approach, user involvement, open collaboration, real-world experimentation, co-creation, and multidisciplinary engagement of various stakeholders from different areas, actively contributing to the development and validation of novel solutions tailored to tackle real-world dilemmas. Thereby, the following definition is proposed by the researcher:

"Collaborative, open and user-driven innovation ecosystem that engages diverse stakeholders to ideate, co-create, experiment and continuously improve solutions aimed to tackle emergent societal and technological challenges, with active end-user feedback".

Furthermore, LL has been conceptualized and viewed from different perspectives, such as an *environment/milieu,* which provides dynamic spaces for the innovation and co-creation process (Bergvall-Kåreborn et al., 2009), *methodology*, providing a structured framework for user engagement, experimentation, and solutions enhancement (Eriksson et al., 2005, p. 5), *context*, catalyzing to accelerate innovation by tackling real-world challenges (Leminen, 2015, pp. 24–25) and *systems*, including networks of processes and components that encourage experimentation and knowledge exchange (Bergvall-Kåreborn et al., 2009), complementing the perspective on LLs.

When researching LL, different levels of analysis shed light on diverse aspects of innovative ecosystems. Schuurman et al., (2015) extend the analytical framework by introducing distinguished levels of research – *macro, micro,* or *meso* level - to better understand the dynamics of LL innovation ecosystems, activities, and interactions between actors (Schuurman et al., 2015).

The *macro level* focuses on stakeholders and context analysis within LLs constellations, involving structured stakeholders engaged in open innovation, with a primary focus on knowledge exchange among organizations. The *meso level* delves into the exploration of LL as an innovation ecosystem, including multiple individual LL projects within the constellation. This level explores the dynamic of collaboration, knowledge sharing, and innovation processes within the LL context, employing specialized methodologies inherent to the LL framework (Schuurman et al., 2015). The *micro level* directs attention to individual LL projects, highlighting specific tools and methods designed to facilitate the accomplishment of activities and projects. It explores details of user engagement, co-creation, and innovation aspects within specific projects, intending to reveal insights that enhance the understanding of LL dynamics (Schuurman et al., 2015).

The authors highlighted that this layered model is not hierarchically organized, offering a systematic framework for analyzing LLs, enabling researchers to further explore the diverse facets across varying levels of detail (Schuurman et al., 2015). In this research context, the focus lies on the *meso level.*

2.2.2 Characteristics of Living Labs

According to Ballon & Schuurman (2015), adopting an LL approach offers three primary advantages: i) facilitates the development of context-specific insights into development, adoption, and their interplay; ii) experimentation shedding light on conditions that can encourage the integration of technology into society; iii) immersing technology in real-life contexts provide a visualization of potential societal effects arising from innovation.

Even though the LL approach is a multi-staged innovation process, there is no consensus on the number or nature of these stages among scholars and practitioners. Feurstein et al. (2008) proposed four phases - *product idea, concept, development*, and *market launch;* whereas Bergvall-Kåreborn et al. (2009) suggested a three-phased process - *generate needs*, *design*, and *evaluate*, iterated through concept *design, prototype design*, and *final system design* cycles; and European Commision (2009, pp. 7–9) argued the importance of undertaking four primary activities: co-creation, in which users and producers are engaged in collaborative design efforts, exploration, where emerging behaviors, usages, and potential market prospects are identified, experimentation, referring to the implementations of real-world scenarios within user communities and

evaluation, which assess concepts, products, and services based on socioergonomic, socio-cognitive and socio-economic considerations.

Additionally, Mulder & Kriens (2008, pp. 3–5) presented six perspectives encapsulating the fundamental aspects and multifaceted nature of a LL. *User involvement* is an essential key element within mature LLs, requiring a dual focus. Firstly, unobtrusive measurement of user activity is crucial to sense regular user behaviour. Secondly, user acceptance of data collection and its interpretation is imperative for iterative design. This engagement, driven by organizational, contextual, and technological aspects contributes to an effective collaborative creation and facilitates real-world testing.

Service creation implies developing new ideas, focusing on collaborative efforts between users, researchers, and stakeholders, and testing and integrating real-user data into the design process. Due to the nature of LLs, this involves establishing a collaborative and participatory ecosystem that engages diverse stakeholders, such as cities, universities, commercial entities, and organizations, representing sustainable open innovation. Also, the authors emphasize the significance of service creation by coordinating it into three types of horizontal service structures (Ballon, 2015): technical services for communication, collaboration, prototyping, validation, and others; customer services for innovation, idea generation, business support, community services, and others; and intra-network services for governance, management, and training.

Infrastructure perspective incorporates crucial services and technologies established within LL required for data collection, measurement, and analysis, both physical and digital infrastructure, to facilitate experimentation and innovation. Notably, LL-controlled services are excluded yet include open networks and sensor-equipped devices.

Governance highlights effective management, coordination methods, and member interactions for coordinating activities, collaborations, and decision-making within the LL environment. It addresses the importance of establishing structures, policies, and methods to guarantee transparent input, stakeholder engagement, and organizational alignment, facilitating the accomplishment of LL's objectives.

Innovation results underline the *tangible innovation outcomes* produced, spanning the development and design of new products, services, and processes as a direct outcome of co-creation within the LL environment, which contributes to societal and economic advancement.

Methodologies and tools are necessary for acquiring extensive user data, fostering innovation, and promoting collaboration within LL. It entails a wide array of methods, frameworks, and tools that structure activities, analyze data, and assess user engagement, including processes such as ideation, co-creation, and iterative design.

Moreover, other authors have proposed a range of key principles and characteristics (Bergvall-Kåreborn et al., 2009; Compagnucci et al., 2021; Mulder & Kriens, 2008; Ståhlbröst, 2012, p.60). Bergvall-Kåreborn et al., (2009) have outlined a set of key principles that capture the essence and operational dynamics of LLs, shaping the core methodology and underlying philosophy of LLs within the context of innovation and collaboration: *Openness, Influence, Realism, Value* and *Sustainability.*

LLs highlight an environment characterized by *openness* as vital for the innovation process, prioritizing transparent communication to facilitate the exchange of knowledge and ideas among diverse stakeholders. This aims to potentially accelerate development, nurture new ideas and uncover unexpected business opportunities in markets (Bergvall-Kåreborn et al., 2009).

The *influence* principle stresses the user's perspective as dynamic and proficient collaborators, involving a diversity of participants, such as users, researchers, entrepreneurs, and organizations. By actively participating in the innovation and development process and therefore, influencing the trajectory and results of projects, users contribute to shaping project outcomes (Bergvall-Kåreborn et al., 2009).

The essence of LL methodology rests on conducting innovation activities within real-life settings, using authentic scenarios and user behaviors to yield valid results applicable to real markets and focused on actual needs and challenges faced by users and stakeholders (Ståhlbröst, 2012, p.65). The *realism* principle discourages overly speculative or idealistic pursuits, promoting a pragmatic alignment of objectives with the genuine limitations and prospects that define the innovation landscape (Bergvall-Kåreborn et al., 2009).

The notion of *value* concerns the importance of extracting meaningful and tangible results from LL initiatives, bringing economic, societal, or technological value to the diverse stakeholders engaged in the process (Ståhlbröst, 2012, p.63). Additionally, it is important to translate innovation into practical utility, advocating for an assessment of the impact and relevance of innovations for both users and stakeholders (Bergvall-Kåreborn et al., 2009).

Sustainability within LLs incorporates its viability and responsibility to the wider community. Ensuring viability implies continuous learning, research translation of knowledge into practical models, partnerships and cross-border collaborations, which nurture innovation and trust-building (Ståhlbröst, 2012, p. 64). To achieve such results, a holist approach is employed, integrating ecological, social, and economic aspects to ensure that innovations contribute to the long-term vitality of LL, align with resource preservation and societal well-being, for both current and future generations (Bergvall-Kåreborn et al., 2009).

These principles serve as guidelines to enhance the output of their innovation development process, leading to specific objectives and corresponding strategies needed to be employed to achieve them. Each principle addresses a distinct facet of the organizational structure of LL and their innovation processes, while collectively, establishing the core philosophy and operational framework, encapsulating differentiation factors that distinguish LLs from other innovation methodologies (Bergvall-Kåreborn et al., 2009).

By adopting the given principles, the foundation for shaping the distinct characteristics of LLs is built. While Leminen et al., (2012, p. 7) argue that one of the most significant characteristics of LLs is that they are open-innovation networks, Hossain et al., (2019, pp. 9–20) have identified a set of key characteristics that highlights its complex nature, main elements that define and shape its functioning and underline their role as dynamic and inclusive spaces for innovation.

- Operate in *real-life environments*.

- Engage with various *stakeholders*, fostering a collective exchange of different perspectives and expertise.

- Dynamic and cooperative *variety of activities*, such as idea creation, prototype development, user testing, feedback collection to iterative enhancement, nurturing a continuous innovation process.

- Function within a specific *business model*, that portrays the creation and exchange of value among stakeholders, and operates as part of an extensive network, that promotes the exchange, collaboration and resource sharing, amplifying the scalability and impact of the developed innovations within LLs.

- Use of diverse *methods, tools, and strategies* tailored to the particular objectives and context of LLs, all to facilitate the process of innovation.

- Addressing and tackling *challenges* encountered throughout the innovation process, contributing significantly to the refinement and optimization of innovations.

- Generate *tangible outcomes*, in the form of novel products, services, technologies or policies, as a result of the collaborative process of innovation.

- Commitment to develop *sustainable* and impactful solutions considering enduring viability, economic feasibility, and environmental implications of the innovations.

In addition to these characteristics, Følstad (2008, pp. 110–112) emphasized user-centric and multi-disciplinary collaborative characteristics, resulting in LLs acting as bridge that connects research organizations, industries, and stakeholders, and thus facilitating the exchange of knowledge and resources, leading to the effective scaling of innovations. cover diverse contexts and exhibit dynamic compositions with varied driving forces that influence the collaborative innovation course, emphasis, and duration (Leminen et al., 2012, p. 7).

2.2.3 Models of Living Labs

Innovation networks manifest in diverse shapes and structures, adapting in response to shifts within industries to achieve specific goals (Feurstein et al., 2008). Open innovation networks focus on co-creation principles, fostering value generation for both companies and users. Conversely, user innovation networks adopt a horizontal structure emphasizing the active involvement of users in the innovation process.

Leminen (2015, pp. 48–51) refers to five approaches to examining LL networks: *Network of LL networks,* which explores the interdependencies and interactions amid different LL networks and their role in innovation processes; *LL in Innovation System*, viewed as essential components of larger innovation systems, exploring their interactions within the innovation ecosystem, along research institutions, businesses, and government bodies; *Cross-border LL network,* with LL from different regions collaborating for global innovation and cross-border cooperation; *Dual LL network*, connecting two different types of LLs with distinct goals, tasks and user groups, analyzing how they interact and collaborate towards innovation outcomes; and lastly as *Single LL network with multiple stakeholders, the* earliest type of LL identified, in which incorporates a diverse set of stakeholders, to assess their contributions to LL's activities, co-creation innovation and collaborations in the innovation process.

Existing literature categorizes various types of LL networks and analyses the interactions between actors to facilitate innovation through open innovation principles. These studies highlight their interconnectedness through diverse methods, contributing to innovation systems and incorporating numerous stakeholders within individual LL networks (Leminen, 2015, p. 51). This being said, LL networks serve as interconnected ecosystems of collaborative innovation, linking multiple LLs to facilitate shared learning, resources, and expertise.

Within these networks, various LL models are employed to engage stakeholders and co-create solutions. The aim is to accelerate the development and adoption of innovations while addressing diverse challenges across multiple domains. Such models depend on different norms, encompassing driving actors, focal domains, or organizational structures. Leminen et al., (2012, pp. 8–9) portray four distinct models of LLs, differing based on the type of actor that drives the activities of the LL.

- *Utilizer-driver:* primarily managed by companies, oriented towards advancing business objectives and commercial development. Activities are informally organized, and directed by users, but not managed by them.

- *Enabler-driven:* projects within the public sector designed and strategically aligned to achieve regional development goals.

- *Provider-driven:* initiated by developer organizations (educational institutions, universities or consultants) to foster research and knowledge creation, and academic collaboration. A provider facilitates operations and influences users, characterized by the bottom-up principle, in which other actors support users with resources, knowledge, and guidance.

- *User-driven:* established and led by the user community itself, aiming to tackle particular user-related challenges, generating advantages that have an impact on other stakeholders, through direct or indirect means.

Each model embodies different activities, structure, organization and coordination, objectives, and stakeholders, contributing to the diversity and dynamism of LL ecosystem. Nonetheless, within open-innovation networks, no individual actor holds dominant power over others regardless of their differing roles (Leminen et al., 2012, p. 10).

Even so, a LL operating model allows for experimental setups that are used to test something new and /or a new perspective on the development of existing operations, resulting in a new service, product, experience or social innovation, conducted in an open and participatory test environment (Koivisto et al., 2023, p. 2).

Moreover, amidst the digital, digital LLs have been gaining significant attention as a response to rapid advancements of digital technologies, such as AI, IoT, data analysis and virtual reality Representing a paradigm shift, these digital LLs revolutionize the approach to innovation conception, development, and testing, leveraging on cutting-edge technologies to create collaborative digital platforms where various stakeholders engage collaborative. This enables new level of data-driven insights, remote participation and rapid prototyping. Such platforms facilitate de adopting of LLs methodologies, enabling the study of entrepreneurship and innovation within platform-based settings (Baran & Berkowicz, 2021, pp. 5–6).

This shift allows for research into the development facets within a virtual environment, departing from traditional real-world contexts. The value of digital platforms lies in their ability to offer value to various user groups by enabling experimentation, user engagement, and co-creation within a digital ecosystem. Digital LLs are particularly relevant in today's society, due its increase digitalization and interconnectedness, facilitating the exploration of novel concepts, products and services, leveraging on technological advancements (Baran & Berkowicz, 2021, p. 6).

Such shift led to a transition into a form of platform economy services that connect users and stakeholders. This shift is driven by the recognition of the benefits and efficiencies offered by digital platforms. By leveraging digital technologies, LLs can extend their influence globally, benefiting academia, businesses, government entities, and society. It offers academia access to a more extensive range of data and resources, businesses benefit from direct consumer insights and collaborative partnerships, governments can utilize real-time data for evidence-based policymaking, and society benefits from democratized innovation, inclusive development, and positive societal impacts.

It is possible to conclude that both traditional (physical settings) and digital living labs share the core principles of open innovation, co-creation, and user involvement, yet implement the principles within different contexts and use distinct tools and methods.

2.2.4 Actors and Roles

Cosgrave et al. (2013, p. 672) emphasized the key role of the stakeholders in creating and sustaining a LL, as often their roles imply providing financial support until self-sustainability. Stakeholders, such as universities, are involved in the initial research on the infrastructure and implementation, collaborating with the government in seeking funds and developing services/products to be tested in the labs. The private sector collaborates with the government in funding projects, marketing products/services, and cooperating with universities and the government to conduct necessary research. Public stakeholders provide initial funding for establishing the labs' infrastructure and financial support throughout the process to encourage innovation and testing in the lab (Cosgrave et al., 2013, p. 672). As organizations are primarily driven by the interests of their users, LLs can take on different operational configurations depending on the actors involved, despite common elements.

As LLs transcend their conventional role as testbeds, embracing co-creation by exploiting users' creativity, and thus users shift from passive consumers to active co-creators, influencing and shaping products and services (Schuurman et al., 2016a). Nyström et al. (2014) indicate that users can assume various roles that influence and shape the operation of the LL and the innovation generated by them. The involvement of users enhances their impact and business performance, as their role allows for the acceleration of development, cost reductions, leveraging their knowledge to understand real-life scenarios (Compagnucci et al., 2021, p. 5)

Users can be considered companies, public bodies, professional users, consumers, employers, employees and residents. Kaulio (1998) [as cited in Compagnucci et al., 2021, p. 6] categorized user engagement in LLs into innovation/design for, with and by users, offering a differentiated perception of users: as participants-controlled study environments or as active co-creators with versatile roles (Compagnucci et al., 2021, p. 6).

According to Kaulio (1998) (as cited in Compagnucci et al., 2021, p. 6):

- *Design for:* innovative approach in which the focus lies on creating innovations intended for users, considering their needs and preferences, limited to passive user feedback.

- *Design with:* collaboration with users throughout the innovation process in an iterative way, seeking their input and feedback to refine and develop ideas.

- *Design by*: innovation approach involving users in generating innovation within LLs, showcasing their creative input and expertise. Users as active innovators rather than passive recipients of products or services.

By understanding the diverse and dynamic user involvement within LLs, innovation outcomes are improved and the connection between innovations and their intended beneficiaries is strengthened. Users act as essential collaborators in the innovation process, adapting their involvement to LL initiatives' specific goals and contexts (Schuurman et al., 2016).

In addition, Leminen et al. (2012, pp. 8–9) categorize different actors within the context of LLs: *Providers* who serve as suppliers to other entities, contributing with knowledge and focusing on long-term results; *Users* who incorporate end users, customers, or citizens who are subjects of study or actively participate in innovation endeavors; *Utilizers*, involve companies or organizations that aim business growth via short-term LLs cases, focusing on developing and testing novel products and services; *Enablers*, involve various public sector actors, financiers or non-governmental organizations that offer resources (financial or policy support) to initiate and sustain LLs initiatives.

This categorization model allows to observe the strong connection of the LL concept with the open innovation paradigm. Depending on the driving actor and activity focus, various LL types emerge (Schuurman & Tõnurist, 2017, p. 9) such as *research labs* (focus research on different aspects of the innovation process), *corporate labs* (focus on physical spaces to co-create with other stakeholders), *organizational labs* (where members of an organization collaborate in the development process) or *intermediary labs* (focus on having different partners to collaborate in a neutral arena).

LLs excel at incorporating various approaches, such as multidisciplinary, multi-method, and multicultural aspects, represented and shaped by their participants, and thus, their roles and patterns of influence play a key role in driving innovation within LLs.

According to Nyström et al. (2014, pp. 487–489), LLs demonstrate four characteristic role patterns: *ambidexterity* (Tushman et al., 1996, p. 24), referring to one's ability to balance exploratory and exploitative activities (March, 1991, p. 72),, fostering the coexistence of both within LLs environments; *reciprocity*, where it is observed a mutual exchange of resources, knowledge, and benefits between stakeholders, generating a collaborative and symbiotic environment; *temporality*, in which the adaptive nature of LLs is emphasized, evaluating and refining solutions based on real-world feedback and emerging trends; and *multiplicity,* characterized by the diverse and

interconnected roles played by stakeholders, that contributed with varied perspectives and expertise. Collectively, these role patterns emphasize the dynamic, collaborative, and innovative essence, serving as a bridge between research endeavours and practical applications.

2.3 Open and User Innovation Paradigms

In the past decade, new forms of innovation have been emerging. The characteristics of LLs are primarily intertwined with diverse paradigms, and within the literature, two key paradigms are highlighted: *open innovation* and *user innovation* (Hossain et al., 2019, pp. 7–8).

Open innovation involves a collaborative approach between internal and external actors who form partnerships for research and development, exchanging ideas and resources (Chesbrough, 2003, p. 37). Baldwin & von Hippel, p. (2011, p. 1406) suggest that open and collaborative innovation, involving user engagement and the open sharing of individual and collective efforts, can result in unlocking new opportunities for innovation and better addressing the needs and challenges of the market. OI encourages collaboration across boundaries, whether those are organizational, disciplinary, or geographical, allowing organizations to access a broader range of perspectives and capabilities, accelerating the development, effectiveness, and adoption of new solutions, since the organizations interact to form networks of innovation and provide collective knowledge.

User innovation stresses the diverse needs and innovative capabilities of users, who actively contribute to the development or improvement of a product or service, inputting valuable feedback. This approach allows for rapid prototyping, testing, and iteration of innovations, leading to the refinement or creation of entirely new products (Schuurman, 2015, p. 196).

LLs excel in combining both paradigms, by actively involving various stakeholders in collaborative innovation (Schuurman et al., 2016b, p. 326). Some scholars view LLs as a form of open innovation (Westerlund & Leminen, 2011, p. 20), while others consider them part of open innovation networks, whereas diverse stakeholders collaborate to tap into external sources of innovation, facilitating the development of new products or services (Leminen et al., 2012, p. 10; Veeckman et al., 2013, p. 4). Comparative studies emphasize similarities and differences between LLs and open innovation. (Almirall et al., 2012, p. 12) see LLs as structured open innovation that enable connections between stakeholders, while others differentiate them from open innovation due to their orientation towards users, products and services in a business-to-consumer setting, while

the open innovation paradigm often revolves around business-to-business contexts (Bergvall-Kåreborn et al., 2009), or as part of a company's innovation management approach.

Furthermore, user involvement emerges as a key element of LLs with essential roles in innovation activities. (Bergvall-Kåreborn et al., 2009) portray LLs as an intermediary community aligned with user innovation, Leminen (2013) claims user involvement to address their needs, which can be community-led or bottom up, (Almirall et al., 2012, p. 15) map various forms of user engagement, emphasizing LLs' real-life application. User participation varies in relation to the type of LL, where roles, both active and passive, are needed for user-driven innovation, indicating a shift towards co-creation with users (Hossain et al., 2019, p. 9).

The European Commission (2009, pp. 7–8) empowers users to contribute to research, development, and innovation process, including the creative process to uncover emerging behaviours and user patterns. It bridges the gap between the advancement of technology and product adoption, simplifying the assessment of the socio-economic effects of novel technologies (European Commission, 2009). User-driven open innovation and LL methodologies offer different benefits to various stakeholders, like:

- *Users as citizens and communities,* empowered to influence and shape services and products to fulfil real needs while actively participating in research and innovation lifecycle, leading to cost reductions and process developments.

- *Small and micro-entrepreneurs,* in developing, validating, and expanding novel ideas rapidly while entering broader markets.

- *Larger corporations,* partnering with other companies and end-users for a more efficient innovation process, to result in heightened accuracy.

- *Researchers, economy, and society*, encouraging dynamic service and technology innovation ecosystems through business-citizens-governments collaborations, merging technological and social innovation to boost ICT R&D and innovation returns on investment.

Leveraging user and open innovation approaches within LLs, companies benefit from an active collaborative ecosystem for co-creation, testing and refining innovative ideas, mitigating risks and costs and facilitating further improvements, resulting in more impactful outcomes (Compagnucci et al., 2021, p. 13).

In addition, social innovation has been recognized as key to community empowerment, a paradigm that intersects and complements open and user innovation. The interplay between these concepts arose in collaborative initiatives involving both public and private actors working towards fulfilling the social needs of communities (Martins & de Souza Bermejo, 2014, p. 145). Despite having different focuses and approaches, they complement each other amplifying their impact.

Social innovation is a participatory approach involving diverse actors, such as individuals, communities, social groups, organizations, and governments, seeking to address social needs or improve common well-being (Martins & de Souza Bermejo, 2014, p. 147). Driven by social demands, it entails engaging those affected directly in the design, implementation, or adoption of solutions of innovation (Da Silva & Bitencourt, 2019, p. 18).

The symbiotic relationship between both innovation types is evident as social innovation embodies principles of open and user innovation when organizations engage to address societal needs (Martins & de Souza Bermejo, 2014, p. 158). Therefore, when open innovation is used to meet a social need or change community practices, innovation is also social. Hence, the common characteristic is collaboration, since open and user innovation can contribute to social innovation (Martins & de Souza Bermejo, 2014, p. 158).

Moreover, the merging of social and open innovation gives rise to the concept of "*Open Social Innovation*" which aims to tackle social challenges through collaborative processes. This approach underlines co-creation and acknowledges the collective nature of value creation (Martins & de Souza Bermejo, 2014, p. 152). Chalmers (2013) [as cited in Martins & de Souza Bermejo, 2014, p. 151] merged the two concepts, suggesting that open innovation can ease barriers to social innovation, whereas social innovation aligns with open innovation through collaborative methodologies among diverse stakeholders and users in the development of innovations. Similarly, open innovation intersects with social innovation through initiatives like non-profits reshaping society (Martins & de Souza Bermejo, 2014, p. 152).

Within LLs, these innovations converse, with end-users as co-creators and testers, fostering open innovation and knowledge sharing for rapid prototyping, whilst social innovation ensures solutions that tackle broader societal goals.

2.4 Harmonization of Living Labs

Presently, a vast variety of actively operational LLs exists, albeit a high percentage is observed within the EU milieu (Dutilleul et al., 2010, p. 63). To catalyze innovation and fully leverage their potential, it is imperative that LL mature. EU is putting efforts to standardize best practices for establishing and conducting LL research, as it is acknowledged their key role in bridging gaps in technology management, development, and market entry, as well as role in facilitating the demand-driven "concurrent innovation" that involves all key actors iteratively, with users at the forefront. The process starts by gathering relevant actors during the research phase, transitioning from prototypes to practical products – crossing the "*pre-commercial gap"*, through iterative user engagement, boosting value in rapid product development (Figure 1) (Eschenbächer et al., 2010, pp. 22–23).

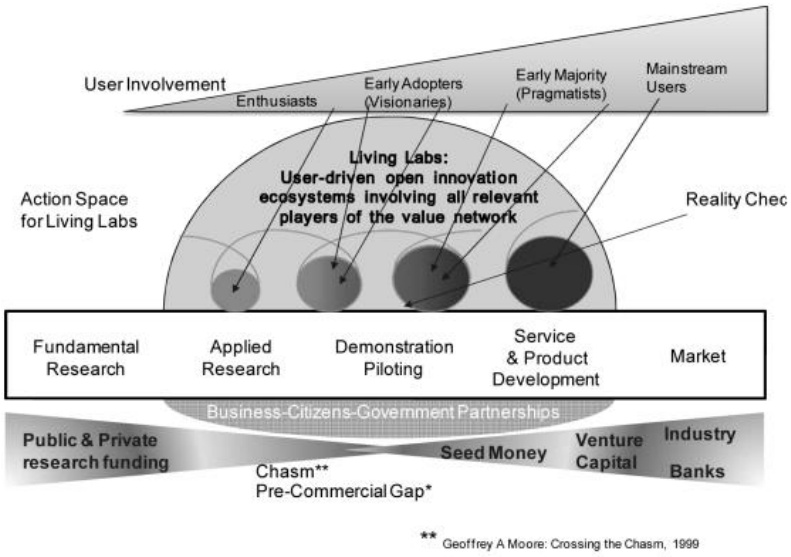

Figure 3 LL research position in the innovation process (Eschenbächer et al., 2010, p. 25).

Veeckman et al. (2013, pp. 15–16) explore how the key characteristics of LL are connected to resultant outcomes, improving the innovation process:

- User-centricity approach → *Relevant and user-approved solutions.*
- Real-life context → *Real-world validated and practical innovations.*
- Open and Collaborative Innovation → *Diverse and high-quality solutions.*
- Multidisciplinary collaboration → *Holistic and well-designed solutions.*

- Iterative development process → *Iteratively improved solutions.*
- User involvement throughout the lifecycle → *Higher user acceptance and adoption.*
- Testing and validation→ *Enhanced solution reliability.*
- Innovation ecosystem → *Scalable and sustainable solutions.*
- Contextual research methods →*Insights-informed solutions.*
- Inclusive participation → *Inclusivity-driven solutions.*

Considering that assessing these outcomes is fundamental, the "*Living Lab Triangle"* arose (Figure 2). It consists of a conceptual framework that assesses LL by triangulating between environment, approach, and outcome, aiding in the evaluation of maturity and identifying areas for improvement. It is considered a useful tool for guiding the development of new living labs or the adaptation of existing ones (Veeckman et al., 2013, p. 6). Hence, this framework assesses how LL characteristics impact their outcome, dividing them into generic levels of environment and approach (Veeckman et al., 2013, p. 6).

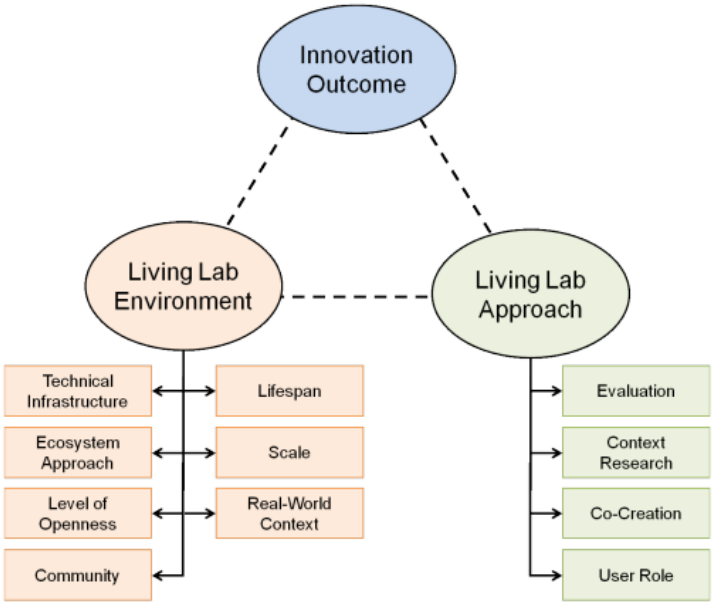

Figure 4 Living Lab Triangle (Veeckman et al., 2013, p. 6).

This concept refers the relationship between the three key components within LL settings, facilitating an analysis of the element's interaction in shaping the dynamics and effectiveness of LLs. The *environment* includes the context in which LLs operate, including physical, social, and cultural

aspects, while the *approach* refers to the methods, strategies, and processes applied to nurture collaboration and co-creation. In Veeckman et al. (2013, p. 6) perspective, the LL environment significantly shapes a project initiative, in which innovation practitioners need to align LL activities with desired inputs and outcomes.

In addition, the authors provided recommendations to ease the successful implementation of projects within LLs initiatives: establish a clear strategic intention, foster shared value creation and sharing among stakeholders, maintain a clear level of openness, ensure a minimum set of users and clear communication, and utilize a mixed set of LL tools to uncover new opportunities (Veeckman et al., 2013, pp. 16–17).

Additionally, Ståhlbröst (2012, p.73) emphasized the key role of LL principles in guiding both the design and assessment of LL initiatives. The author argues that when assessing the LL approach by these principles, both the innovation process itself and the stakeholders involved are impacted.

The LL approach has solidified its position within local and regional innovation systems, employing diverse methods and tools (Schaffers & Santoro, 2010). Yet, their experimental nature – "learning by doing", coupled with disparate setups and limited coordination, has resulted in divergence in approaches, outcomes, and impacts, along with underdeveloped economic rationale and business frameworks, which emerge a need for an analytical framework that facilitates customized collaboration models tailored to each innovative product or service (Eschenbächer et al., 2010, p. 24).

Eschenbächer et al. (2010, p. 24) emphasized in his study the key success factors for LL: trust, clear rules, and active key persons. With project-based development as a standard operating model, emerges a need for a standardized research infrastructure, methodology, and terminology. At the operational level, challenges might occur related to missing business propositions, unrecognized services, project-based funding, and sustainability concerns, which may stem from the lack of defined service portfolios, limited proactive marketing, and resource constraints, often managed by universities or city officials, potentially hinder development (Eschenbächer et al., 2010, p. 26).

Moreover, the LL approach lacked a standardized reference methodology to support the innovation process in creating new products and services and the establishment of a new LL. Harmonization of LL methods and tools is key to regional growth and development impact, yet methods

and tools used differ widely. Therefore, it is important to achieve harmonization within and out of LL. (Mulder & Kriens, 2008, p. 5).

The literature on assessing LL approaches lacks consensus. Some emphasize openness (Leminen et al., 2012) and transparency in research methods alongside developing competence and commitment to openness principles (Vervoort et al., 2023, p. 12). Others propose harmonization approaches for LL evaluation frameworks (Mulder & Kriens, 2008). Elements such as user engagement, service creation, infrastructure, governance, innovation outcomes, and methods/tools like the iterative LL approach are considered. Other scholars also stress understanding LL architectural aspects and effective management approaches (Hossain et al., 2019). A classification system based on macro, micro, and meso levels, by Schuurman (2015), holds potential but needs integration into existing LL evaluation frameworks. Here is important to consider that inadequate frameworks may hinder LL sustainability and impede impactful structures (Vervoort et al., 2023, p. 2). To address this, Vervoort et al., p. (2023, p. 12) propose an improved evaluation framework, new chapters, and criteria to standardize methodologies and support LL innovation processes.

Strategy	*Governance*	Well-defined and shared vision and mission for the LL, based on identified QH needs, engagement of all QH actors, clear team roles, and description of expected outcomes and impacts.	Macro level (Consider multistakeholder participation, and collaboration strategies and explore LL business model)
	Business Model	Sustainable finances and a well-described service portfolio for innovation and collaboration.	
	Culture	Connections with external innovation ecosystems, adaptive collaboration within the LL and quality of internal communication processes.	
Operations	*Operations*	Experience in running projects, monitor processes for operational aspects, impact measurement, partner agreement, branding.	All Levels (Considering the way LL manages its operations)
	Human Resources	Availability of qualified staff, role distribution based on needs and labour division.	
	Equipment and infrastructure	Access to necessary resources and timely availability.	
Openness	*Innovation processes and partnerships*	Level agreements, transparent data agreements, transparency, and openness to new partners and investors.	All Levels (From macro-meso-micro level perspective)
	Ownership of results	Feedback protection, shared vs formal ownership, and quality of IP processes.	

Users and Reality	*Quality of the iterative process in real-world settings*	Adoption of iterative methods and user involvement.	All Levels (Considers the ways of collaboration with users and level of engagement and participation)
	User-centricity of the user and stakeholder engagement approach	User impact, panel representativity, permanence, and activity levels.	
	Quality of participatory tools and methods	Engagement strategies, tool range, innovativeness, and external communication quality.	
Impact and Value Creation	*Co-created values*	User and stakeholder satisfaction, knowledge exchange, academic validation, knowledge sharing, capacity building, technology readiness level, value chain coverage, and value capture strategies.	All levels (Cover co-created values, such as knowledge sharing, capacity building, and network building, by whom and for whom)
	Impacts of the LL	Internal learning, societal, economic, environmental, and regulatory impacts.	
Stability and harmonization	*Stability of the LL*	Funding, partnerships, collaboration, SWOT analysis, and future business plans.	Macro (Consider different needed aspects like business model, service offerings, and strategy plans)
	Harmonization and scale-up	Standardized procedures, project management, tools, methods & technologies, replicability, collaboration quality, knowledge sharing, and capacity building.	

Figure 5 Evaluation Framework of a LL (Adopted framework) (Vervoort et al., 2023, pp. 12–15).

The proposed evaluation structure (Table 3) supports evaluators and LL networks in understanding how well they can function across different levels while also supporting individual LLs in conducting regular self-assessments based on six key building blocks. Achieving a maturity model promotes professionalization and sustainable LL architecture. Implementation of this evaluation structure enhances the quality of LL organizations, sustainability, effectiveness, and impact, aiding in evaluating the performance and effectiveness of LLs across various dimensions (Vervoort et al., 2023, p. 16).

2.5 Triple / Quadruple Helix Model and Living Labs for Regional Development

In the current economy, regions compete by leveraging their knowledge to advance innovation and attract more stakeholders. Citizen involvement became vital, driving the creation of innovative concepts that enrich the innovation system (Eriksson et al., 2005, p. 4). Hence, such knowledge-based economic development can be achieved through the collaboration of innovation networks and clusters involving universities, companies, and governments to innovate and engage users throughout the process (Etzkowitz & Klofsten, 2005, p. 243). In this context, regional innovation is viewed as a dynamic process driven by the exchange of knowledge assets within interorganizational networks, and a crucial step for organizations to adapt to changing environments and enhance performance (Del Vecchio et al., 2017, p. 2).

Regional innovation systems promote interactions between innovative actors and local business capacity, and thus, require adaptability due to regional uniqueness, fostering collaboration and knowledge-sharing for new ideas and solutions that benefit the region as a whole (Prasetyo et al., 2023, p. 2).

In the context of the EU, and its effectiveness in knowledge creation yet relative inefficiency in converting it to society and market value – the "*European paradox*" (Compagnucci et al., 2021, p. 4), the Triple Helix Model (THM) for innovation emerged. Proposed by Etzkowitz, this model serves to aid in addressing this gap as well as serve as a guide for crafting policies that enhance innovation support and conditions, as it advocates collaboration between academia, industry, and government, with a potential to enhance regional development and foster a knowledge-intensive society. However, this type of collaboration might not fully serve and meet citizens' needs and emerging sustainable development challenges, leading to the emergence of the Quadruple Helix Model (QHM) (Priday & Pedell, 2017, p. 555), which systematically describes the complex network of partnerships and collaborations that enhance a region's innovation capacity (Del Vecchio et al., 2017, p. 3).

The THM involves three actors, whilst QHM adds a fourth: Civil society. Citizens play a key role in regional innovation, contributing as co-creators of a wide future beyond individual efforts, actively participating in the development of innovations, and linking users with stakeholders. QHM embraces user-oriented innovation, nurturing idea cross-fertilization and real-world prototyping, whereas scientific knowledge must meet social robustness and inclusivity standards (Arnkil et al., 2010, pp. 14–16).

The QHM provides a framework for understanding regional growth dynamics based on the processes of creation, diffusion, and value of knowledge assets and collaboration of diverse actors (users, companies, universities, and governmental bodies) (Carayannis & Campbell, 2010, p. 51). Depending on the context, end-users can be companies, organizations, civil society associations, professional users, ordinary or amateur users, consumers, employees, residents and citizens as well (Arnkil et al., 2010, p. 17) in which can participate at different levels of intensity (Del Vecchio et al., 2017, p. 3) operating as co-designer and co-producer of innovation, playing an equally important role in the innovation process (Eriksson et al., 2005, p. 6).

The QHM represents a significant change in the approaches for territorial development, empowering all four categories of participants with direct access and control over community-wide issues (Arnkil et al., 2010, p. 18). This mirrors the dynamics found in LL.

As Europe has shifted towards knowledge, and citizen-centric innovation (Priday & Pedell, 2017, p. 555), LLs are playing a crucial role in the QHM to tackle economic competitiveness and societal sustainability issues (Dutilleul et al., 2010, p. 60), countering the "*European Paradox*". By this means and from a QHM perspective, LLs serve as mediators that enhance interactions among this model pillars, facilitating collaboration among various stakeholders (Compagnucci et al., 2021, p. 5) through PPP, fostering experimentation within innovation ecosystems and serve as the foundation for regional support of endogenous development, competitiveness and growth (Arnkil et al., 2010, p. 15). This user-centric involvement distinguishes LLs from other innovation approaches (Del Vecchio et al., 2017, p. 13).

QHM enhances the innovation ecosystem, ensuring the validation of products and service innovations incubated and nurtured within the LL (Eriksson et al., 2005, p. 6). The adoption or integration of an LL approach into existing regional frameworks requires consideration of the specific regional context. It requires collaboration among key stakeholders at the regional and cities level, potentially through a PPP program for regional innovation. This approach mitigates project fragmentation and incentivizes progress from application development to commercialization. Regional collaboration and coordination facilitate systematic networking, knowledge sharing, and scaling up, and thus, practical implementation of the LL will be established as an open innovation project environment supported by thematic open innovation communities and robust processes for setup, operation, and management (Schaffers & Santoro, 2010).

Hence, operating by THM/QHM and the role of HEIs, LL in broader regional innovation ecosystems are essential to understanding how HEIs LL-led initiatives contribute to collaborative innovation

processes involving academia, industry, government, and society. It offers strategic insights into how such LLs align with regional development goals, such as economic growth, social inclusion, and environmental sustainability. Examining the interactions between HEIs and various stakeholders' sheds light on how LLs can leverage academic resources and expertise to address regional challenges more effectively.

2.6 Living Labs in Higher Education Institutions (HEIs)

In today's dynamic society, there is a continuous emergence of complex societal challenges, demanding a new set of skills and competencies from professionals, who are expected to drive innovation and navigate these complexities within organizational settings, approaching LLs as a way to collaborate and tackle complex issues and serve as an educational environment to prepare higher education students for future roles. This bridges higher education, professional practice and research in real-world settings (van den Heuvel et al., 2021, p. 30).

Trencher et al. (2014, pp. 151–152) explore the shift in the societal role of modern universities, arguing that universities are increasingly engaged in collaborative efforts with government, industry, and civil society to boost sustainable transformation within specific geographical areas or societal sub-systems, describing such role as "co-creation for sustainability". This represents a novel and still evolving mission for universities that extends beyond the economic focus and traditional technology transfer practices, involving universities in partnering with local government, industry, and civil society to drive tangible and sustainable transformations within a region (Nyborg et al., 2023, p. 2). As a result, one of the co-creation tools adopted by universities, industry, and the public sector is the "Living Laboratory" (Nyborg et al., 2023, p. 3).

The shift can also be associated with the transition from building-designed laboratories designed to run experiments under controlled conditions, to using campus, involving staff and students as active participants of the experiment. In this context, universities become living laboratories, tangled in co-creative relations (Nyborg et al., 2023, p. 2). Universities use LLs as dynamic platforms to collaboratively shape sustainable regional change, advance practical teaching and research and promote social learning (Evans et al., 2015; Trencher et al., 2014). In light of this, Evans et al. (2015, p. 2) explain that within academic settings, LLs offer real-world exposure and applied research opportunities to prepare students for a competitive job market. Participation in such

initiatives positively impact student's professional and personal development, by enhancing their knowledge and competencies skill set (Falk-Kessler et al., 2007, pp. 90–91).

Moreover, universities of applied sciences have established various LL environments to contribute to working life reform and regional development. These environments serve as functional hubs for research and development, connecting businesses, educational institutions, research organizations, and students (Koivisto et al., 2023, p. 1). They provide lab infrastructure and by promoting teaching, supporting working life, fostering regional development, and encouraging continuous learning, universities of applied sciences extend their support to public and private organizations facing complex challenges, limited access to research and development and striving to innovate (Koivisto et al., 2023, p. 3).

Additionally, in this context, LLs exhibit three core characteristics: confined within specific geographical or institutional boundaries, conduct intentional experiments involving social and material changes, and actively embrace iterative learning (Evans et al., 2015, p. 3). Operating as experimental governance, where various stakeholders and users test new technologies and solutions to address societal impactful issues (van den Heuvel et al., 2021, p. 31), emphasizing monitoring and learning approaches whilst experimenting in real-world settings, ideal for connecting students with applied research by bringing together researchers, students, external stakeholders, and university staff to collectively generate knowledge (Evans et al., 2015, p. 1).

Hadfield et al., p. (2023, p. 4) argue that university LLs serve as a current strategy for universities to "*tackle complex challenges by providing a social and material infrastructure for interdisciplinary research, education, and collaborative projects with societal partners*". Despite facilitating experimentation, they also introduce organizational complexities, necessitating a deeper understanding of their institutionalization and governance. Their value proposition lies in achieving research impact, enabling student experiential learning, and integrating stakeholders across institutional boundaries. Yet, challenges such as governance structures, funding limitations, siloed institutional cultures, and limited participation hinder their effectiveness (Hadfield et al., 2023, p. 6).

Thus, four key mechanisms are emphasized to achieve effective governance within LL: (1) build relationships across institutional silos and disciplines to foster trust and collaboration; (2) flexible coordination through inclusive decision-making to align vision and mobilize activities inclusively; (3) communication of value to gain support from senior leadership and enhance impact scalability; (4) investment in people and systems for continuity and expansion of initiatives (Hadfield et al., 2023, p. 7), as further explain on Figure 3.

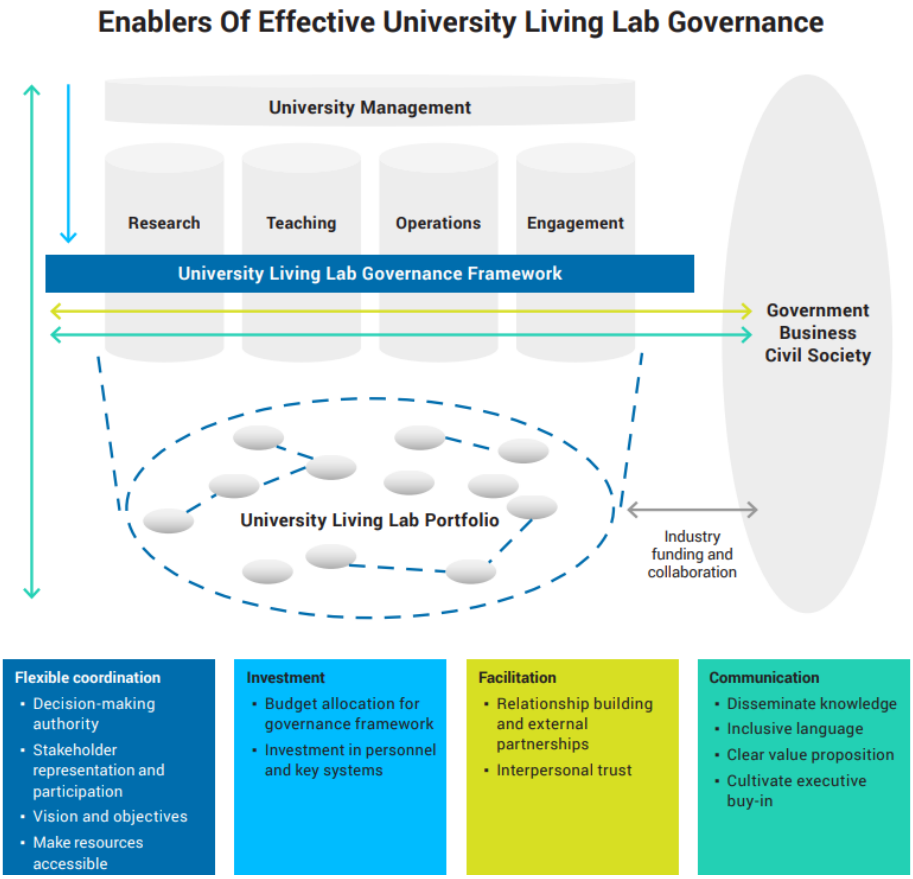

Figure 6 Enables of Effective University LL Governance (Hadfield et al., 2023, p. 66).

As the concept of LL has gained prominence in scientific literature, with a growing number of LLs emerging in different areas, a greater understanding is needed to understand how to effectively operate LLs and successfully integrate higher education with such (van den Heuvel et al., 2021, p. 31). Nevertheless, there are challenges in this matter that involve all stakeholders, including interdisciplinary collaboration, navigating differences in professional language and culture, merging educational dynamics with real-life settings, and matching students' competencies with required field expertise, as the involvement of students is considered fundamental in the process (van den Heuvel et al., 2021, p.31).

LLs offer a strategic framework for co-production processes, allowing consultation with users and stakeholders in the planning of holistic solutions through an iterative approach and providing a coherent basis for long-term action, elements valuable in a university setting research basis (Evans et al., 2015, p. 2). According to König & Evans (2013, p. 12), a LL within academic settings serves as a hub for "*social interaction and engagement leading to knowledge production across organizational and disciplinary boundaries*", whereas van den Heuvel et al. (2021, p. 37)

emphasized real-life settings as fundamental aspect for students to gain practical experiences beyond the limits of the classroom.

The literature underscores that LLs in academic settings are typically seen as research tools for gathering real-world data, conducting scientific studies, and generating knowledge ((Evans et al., 2015; König & Evans, 2013; Trencher et al., 2014). However, a broader perspective considers them as collaborative ecosystems involving multiple stakeholders, which may not always be fully adopted in such settings. Yet, one thing that literature states, is the importance of attitude toward long-life learning among all LL participants in order to create an environment conducive to the success of LL initiatives (Hummels & Vinke, 2010, pp. 2–3).

In a study performed by van den Heuvel et al. (2021, p. 33), stakeholders are recognized with different roles within the operations of LLs in an academic context, engaging in initiatives that generate mutually beneficial outcomes, where students can assume various roles, including learners, peer observers, project leaders, data collectors, analysts, and presenters, with these roles evolving over time, lecturers typically provide guidance, coaching, and instruction, while end users were able to share their insights or function as mentors or trainers. Conversely, industry partners and end-users, who are also engaged, may have a more limited involvement in the academic context.

Furthermore, ensuring the financial sustainability of LLs is an important consideration, as it relies on securing funding and delivering value, either from stakeholder partners in LL or external actors (Gualandi & L. Romme, 2019, p. 15). In terms of project scale, LLs in academic settings tend to be smaller in scale with shorter project timeframes, enabling companies to readily engage with students while providing students access to tackle real-life issues (Nyborg et al., 2023, p. 15).

Nyborg et al. (2023, pp. 4–14) outlined the multitude of purposes of LLs within university settings including:

- *organizational anchoring*, which aims to observe how LLs are funded and integrated into the university's structure and operations, acknowledging the diverse origins of LLs, such as enthusiastic academics, university management, or external funding.

- *industry collaboration*, which investigates how LLs interact and collaborate with external industry partners.

- *student involvement,* which assesses how LLs involve students in interdisciplinary activities, and applied learning opportunities, and promotes entrepreneurship.

- *culture of experimentation,* which explores how LLs conduct experimentation, ranging from closed, controlled settings to more open and participatory models.

- and shaping *identity and communication,* within the academic settings and broader community, which serve as tools for communicating scientific processes and branding the university as innovative and socially responsible.

These aspects can significantly influence the development of universities, scientific practices, and organizational transformation, enhancing adaptability and collaboration. Moreover, it is important to stress the need to address power dynamics and knowledge politics within LLs in academic settings, in terms of considering who participates, how in co-creation activities, as well as promoting diversity, equal participation, and creating an inclusive environment that ensures innovation reflects the interests and needs of a broader spectrum of participants (Nyborg et al., 2023, pp. 13–15).

2.7 Theoretical framework

The literature review served as the foundation for the theoretical framework generated by the researcher (Figure 7).

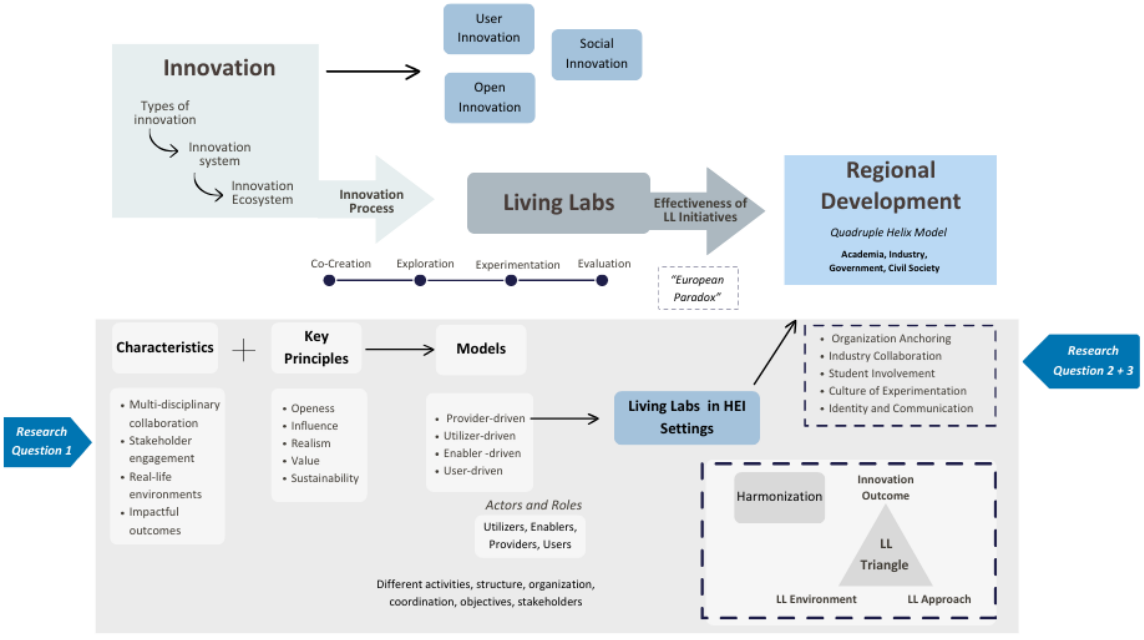

Figure 7 Theoretical framework of the research.

In this study, the researcher examines how KAMK can strategically leverage its LL model to boost innovation and collaboration within its ecosystem, which includes RDI teams, companies, students, and other stakeholders. Hence, the literature review comprehensively analyze LL principles, characteristics, and their impact on HEIs and regional development.

Exploring the principles and characteristics of LL is fundamental for addressing research question one while examining harmonization in LL settings helps establish a basis for exploring research question two. Moreover, exploring harmonization, and innovation outcomes within LL sheds light on addressing the "European paradox" and its impact on regional development within the quadruple helix model, thereby aiding in answering research question three.

By aligning the research with existing theoretical frameworks and concepts, the researcher offers the base for understanding how KAMK can harness the potential of its LL to drive innovation, collaboration, and economic development in the Kainuu region.

3 Commissioner

KAMK is an international institution of applied sciences, praised for its contributions to regional and national innovation, located in the Kainuu region of Kajaani, with around 37,000 inhabitants. Established in 1992, KAMK is committed to providing a diverse and high-quality education and student guidance, offering a variety of bachelor's and master's degree programs in fields such as business, sports, tourism, engineering, and information technology. With approximately 3,300 students and 300 members of staff, and an approximate annual turnover of 26 million, the university aims to establish itself as a global leader in higher education. Based on funding indicators in 2021, KAMK attained the second-highest level of success among universities of applied sciences in Finland of its size (KAMK, n.d.).

Currently, the research institution provides ten bachelor's degree programs in Finnish and four in English; and seven master's degree programs in Finnish and four in English. With expertise in multiple areas, KAMK's Master School provides master's degree programs in business, esports, and engineering, aiming to empower students with the skills and knowledge needed to excel as outstanding professionals in the real world. Their high-quality programs harmoniously blend theoretical knowledge with practical learning to meet current business and industry demands (KAMK, n.d.). Furthermore, KAMK is credited for its exceptional achievements in student satisfaction, research, and innovation. The university actively contributes to the development of businesses and organizations in Kainuu, Koillismaa, and Northern Ostrobothnia regions (KAMK, n.d.).

The research institution is part of the ENIHEI network, involving 38 members from across Europe. ENIHEI serves as a forum that facilitates knowledge, ideas, and experiences exchange related to strategies for higher education institutions to promote innovation, creativity, entrepreneurship, and talent within the educational landscape (European Education Area, n.d.). KAMK, a HEI working in group one, emphasizes the importance of knowledge exchange among network partners. This initiative allows for group members to collectively share valuable insights into LL philosophies and practices(KAMK, n.d.-b)

KAMK conducts demand-driven applied research and development activities, to enhance customers' products, services, and processes, supported by highly trained staff, networks to local and national working environments, and effective project management. Annually, it manages around 60-70 development projects, often in partnership with the EU and other collaborators, to improve businesses' expertise and provide practical learning experiences for students (KAMK, n.d.).

4 Research Design

Research design helps clarifying the methods and approaches employed for data identification, collection, processing, and analysis related to the research objectives. The purpose of this study is to identify how KAMK can strategically leverage an enhanced LL model to develop and strengthen its RDI teams. The objective is to promote open innovation and collaboration within the university, its ecosystem, regional /national companies, and other stakeholders.

Furthermore, this study seeks to answer the research questions, namely:

> Q1: To what extent do KAMK's current RDI labs align with overall established LL principles?
>
> Q2: Which key points should KAMK, and its ecosystem prioritize to strategically develop and enhance its LLs?
>
> Q3: What recommendations can be proposed to optimize the development of KAMK's LLs to tighten the collaboration, boost innovation, and contribute to the economic development of the Kainuu region?

By this means, this research aims to deepen the understanding of LLs within the educational context and explore how can be used in the HEI to enhance students' experience and periphery regions' contexts to drive economic development. The objective is to analyze the contribution of the development of the LLs towards the institution's educational and research objectives, creating a more effective, collaborative, and impactful milieu for research and innovation within the university.

In order to provide a structure to the research and validate the methods used in this study, the researcher begins by stating and clarifying the research design, purpose, approach, and strategy. Subsequently, it outlines the methods for data collection and approaches to data analysis within the context of this thesis. The researcher's choice is driven by the need to understand RDI operations in KAMK's LL environment and what best practices are needed to better sustain and enhance them.

4.1 Research Purpose

Research can be designed to serve various purposes, occurring in various forms. According to (Saunders et al., 2016, p. 174), research purposes can be categorized into different types, such as exploratory, descriptive, explanatory, or evaluative purpose. Also, researchers frequently blend elements from various research purposes to systematically address the research question and objectives.

An exploratory research design seeks to obtain a deeper understanding of a phenomenon or problem that lacks a clear definition or has limited existing knowledge on the topic. It may encourage a reconsideration of the research's value based on its findings and is often used to generate hypotheses for further investigation. Different methods for exploratory research include literature reviews, interviews with experts, individual interviews, and focus group discussions (Saunders et al., 2016, pp. 174–175)

Explanatory research extends beyond mere description and seeks to establish causal relationships or explain why certain events or phenomena occur. Is focused on establishing causal relationships between variables, with the primary objective to understand and explain the connection between different factors. Methods include conducting experiments, longitudinal studies, or regression analysis to identify the factors influencing a particular outcome (Saunders et al., 2016, p. 176)

Evaluative research is conducted towards determining and assessing the efficiency or impact of the performance of something, often within business and management contexts. It compares different aspects to evaluate performance and may contribute theoretical insights by explaining how effective something is and why involving measuring outcomes and determining whether a specific action has achieved its intended goals (Saunders et al., 2016, p. 176).

Based on the purpose of this thesis and research questions, there is a combination of exploratory, explanatory, and evaluative research. Exploratory research as this thesis is a case study that aims to enhance the understanding of LLs and assess how well the activities of RDI teams align with academically established LL principles. In addition, it explores strategies for developing and optimizing the HEI's labs. Furthermore, explanatory research is employed to explain the potential of LLs in promoting innovation and collaborative research, investigate how LL can contribute to economic growth, and identify strategic priorities that KAMK and its ecosystem should emphasize in their LL development, going beyond mere description to uncover causal relationships and explanations.

Moreover, evaluative research is apparent in this research as it seeks to assess the existing situation of KAMK and the effectiveness of strategies and practices employed by well-established EU LLs, aligning to evaluate the impact and outcomes of certain actions or interventions.

The purpose of this thesis is to explore how the development and enhancement of KAMK's LLs can boost the effectiveness to amplify the effectiveness of the RDI initiatives of KAMK within the region, by improving open innovation and encouraging knowledge sharing and collaboration, both internally within the university's ecosystem and externally with companies and governmental bodies. By emphasizing the critical role of HEIs within regional innovation ecosystems, the research sheds light on the systemic change LLs can bring, particularly in peripheral areas.

4.2 Research Approach

The research purpose is closely interconnected to the research approach. The approaches can be portrayed as deductive research, inductive research, or abductive research. The selection of an approach depends on the research questions, objectives, and research problem (Saunders et al., 2016, pp. 144–145).

This study applies an abductive approach, which implies moving between theory and data, blending elements of deduction and induction. Researchers closely observe a phenomenon, collect data to identify themes and patterns, and incorporate them into a flexible conceptual framework. This aids researchers in generating plausible explanations for the observed phenomena (Saunders et al., 2016, pp. 148–149).

The research process in this thesis initiates by collecting and analyzing specific practices incorporated in the case of HEI's RDI teams, in order to investigate its current status and benchmark them against selected partnering HEIs with established LLs. The insights gained from the analysis were then used to draw conclusions regarding the best practices in developing and optimizing an LL, allowing for an enrichment of the knowledge of the subject matter.

The collection of data of this research uses qualitative methods, that allow for an in-depth understanding of the topic. It utilizes a multi-method qualitative study, which implies more than one qualitative data collection technique and corresponding analytical method (Saunders et al., 2016, p. 168). The qualitative methods selected for this study incorporate interviews and collaborative workshops, integrating traditional brainstorming techniques, a collaborative method that allows

the exploration of the research issue by collecting insights and recommendations based on participants' experiences and perspectives. Qualitative benchmarking from the workshop is a valuable research method that collects data and gains insights into best practices, strategies, and approaches utilized by an organization with similar objectives or challenges.

The sample methodology chosen is considered a non-probability sample due to the flexible and purposeful selection of participants, based on the relevance and expertise aligned with the research objectives. According to Saunders et al. (2016, p. 295), there are various alternative techniques for non-probability sampling, and this study relies on purposive sampling, as it enables to precisely target individuals with the necessary knowledge and experiences to provide valuable insight into the research questions and objectives (Saunders et al., 2016, p. 301).

Moreover, content analysis was the approach selected by the researcher to analyze the data collected, aiming to identify themes, patterns, and insights within qualitative data. This approach systematically quantifies such data, by coding and categorizing it, providing objective, systematic, and quantitative descriptions of communication content. The method differentiates between manifest and latent content and can be used to analyze various contexts (Saunders et al., 2016, p. 169).

4.3 Research Strategy

A research strategy consists of a plan of action outlining how the researcher aims to address a research question, seeking to achieve a specific goal (Saunders et al., 2016, p. 177). This study employs qualitative methodology. Qualitative research incorporates various strategies, each differentiating itself from focus, scope, and set of procedures (Saunders et al., 2016, p. 169).

Saunders et al. (2016, p. 169) recognized the main qualitative research strategies including action research, case study research, ethnography, grounded theory, and narrative research. The research strategy selected for this thesis is a case study, as it allows for in-depth investigation and analysis into a specific topic or phenomenon within its real-life context while aiming to understand how the subject interacts with its surroundings and context in which the case exists (Saunders et al., 2016, p. 184). A case study often pursues to gather data from multiple perspectives, to obtain a holistic view of the situation. Given this, the case study of this research pinpoints well-established LLs within ENIHEI members, with the primary objective of exploring the development

and utilization of LLs, with a focus on identifying the best practices associated with sustaining and optimizing its operations.

The study case is a single case, offering an opportunity to explore the LL phenomenon that receives limited attention, in this context (Saunders et al., 2016, p. 186). The research strategy selection is related to the appropriate time horizon, which is adopted a cross-sectional approach, as it explores a specific phenomenon at a particular timeframe (Saunders et al., 2016, p. 200).

In light of this, there is significant interest in further developing and enhancing the LLs' ideologies and initiatives within KAMK's RDI teams, as they represent dynamic hubs for research and innovation, and how this can contribute to the institution's educational and research objectives.

Furthermore, using a case-study approach allows for data triangulation, where multiple sources of data are collected to provide a more complete understanding of the subject being studied. This study collected data from primary sources, such as interviews and collaborative workshops. In addition, it utilized secondary sources, including existing research, literature, articles, journals, and organization websites, to support the literature review and provide contextual background.

In terms of research philosophy, which refers to a system of beliefs and assumptions that influence the development of knowledge in a specific field (Saunders et al., 2016, p. 124), this research adopts an interpretivism approach. It focuses on the interpretation of meaning and understanding diverse and individual social experiences, valuing multiple perspectives (Saunders et al., 2016, p. 140). This approach is relevant in this research given the use of qualitative data derived from interviews and collaborative workshops, where capturing subjective experiences and interpretation is crucial in the context of LLs, and the focus lies on understanding the participants' interaction and involvement in the LL environment. Figure 4 explains the research design for this study.

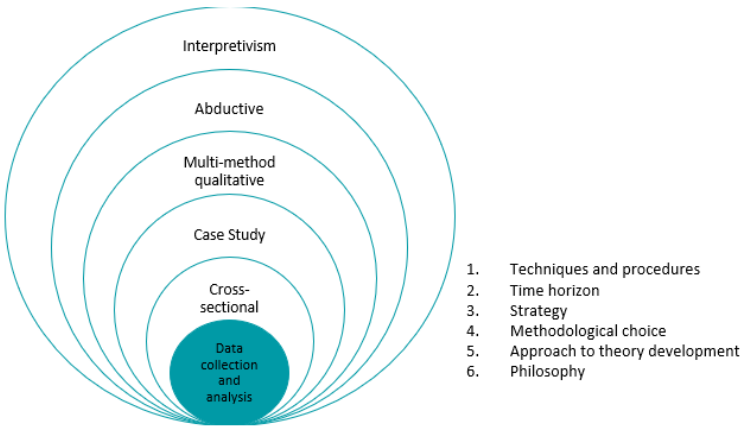

Figure 8 Research Design.

4.4 Data Collection and Development Methods

In terms of data collection and development methods, it is common for researchers to employ multiple methods, leveraging the strengths of each to enhance the analysis. Utilizing various data collection techniques ensures a thorough investigation of the subject matter, which leads to a deeper understanding (Saunders et al., 2016, p. 168).

It involves various techniques and methods to collect data systematically and methodically. Among these approaches, interviews are a commonly used method, considered a key tool for gathering valid and reliable data relevant to the study, allowing the researchers to delve into both objective and subjective perspectives and enriching the understanding of the research phenomenon. The process involves face-to-face or virtual conversations between the researcher and the interviewee, where questions are inquired and responses are documented (Saunders et al., 2016, p. 388). There are different types of interviews, such as semi-structured, in-depth, group, and electronic interviews, that cater to different research purposes and objectives. Semi-structured offer a flexible approach to exploring complex phenomena and understanding participants' perspectives (Saunders et al., 2016, p. 389). Contrasting standardized methods, semi-structured interviews enable adaptability, where researchers can adjust the themes and questions based on the context, omitting or adding questions as needed, depending on the flow of the conversation (Saunders et al., 2016, p. 391).

In addition, benchmarking serves as a complementary tool to the interviews by providing a comparative perspective to analyze organizational practices and processes against industry standards or competitors, aiming to identify best practices and areas for improvement within and across industries (Williams, 2023, p. 27). This approach aids in revealing underlying methods and dynamics that shape organizational performance.

Similarly, in collaborative workshops, a participatory approach to knowledge generation is embraced, leveraging structured group sessions that engage the collective intelligence of diverse participants. Such workshops are specifically designed to produce reliable and valid data about the field in question (Ørngreen & Levinsen, 2017, p. 72). This approach is guided by a facilitator, where there is space for dialogue, co-creation, and collective problem-solving, an environment in which insights can be shared openly and refined collaboratively. Using group dynamics and facilitation principles allows to integration of creative techniques to stimulate idea generation and consensus-building (Ørngreen & Levinsen, 2017, p. 77-78).

Building on collaborative techniques, brainstorming is a creative technique where individuals produce ideas to address a particular problem or topic, encouraging a free flow of thoughts without criticism, and aiming to explore various possibilities. Collective brainstorming expands on this concept by linking a group of individuals to engage in idea generation, leveraging different perspectives and expertise to produce innovative solutions and aiding participants to build upon each other's contributions (Al-Samarraie & Hurmuzan, 2018, pp.78-79).

In this research, the combined intelligence and creativity of a group were harnessed through collaborative workshops that joined collective brainstorming. This approach sought to collect valuable insights, promote collaboration, and inspire new perspectives.

4.5 Quality of Data Analysis

Ensuring the quality of the data fundamental step in academic research. Among the various methods to analyze data, content analysis is the selected approach for examining textual data. It involves coding and categorizing the data, categorizing the qualitative to identify patterns and themes, and the relationship between categories (Saunders et al., 2016, p. 609).

Content analysis employs an objective and systematic approach, defining explicit rules for the coding and categorization of data, predetermined by the researcher before the data collection begins, to ensure consistency and replicability (Saunders et al., 2016, p. 610).

In the preparation phase, data is gathered through various means, such as interviews, and textual documents, among others, followed by transcribing it into text format for simplified detailed analysis. The unit of analysis can vary, from individual words to larger text segments.

In the familiarization phase, researchers engage with the data by reading it multiple times, grasping the overall content and context, followed by the initial note-taking process to capture preliminary thoughts and potential themes. Then, researchers move to open coding, where the text is broken down into segments and labelled with codes, followed by axial coding, which identifies relationships between codes and groups them into broader categories or themes. Subsequently, selective coding refines the core categories to establish a coherent understanding of data, followed by theme development, which implicates grouping related codes into themes that represent significant patterns or concepts within the data. These are continuously reviewed and refined to ensure they accurately reflect the data (Saunders et al., 2016, pp. 610–611).

The interpretation phase of the data involves analyzing context, considering cultural or situational factors, and constructing narratives to explain themes and their relation to the research questions (Saunders et al., 2016, p. 612).

Moreover, there are qualitative analysis software tools that assist in organizing and analyzing large amounts of qualitative data systematically. ATLAS.ti is an efficient example of a tool that helps to streamline the coding and analysis process, enhancing efficiency and accuracy in the content analysis process (ATLAS.ti, n.d.).

4.6 Trustworthiness

Ensuring the trustworthiness of qualitative research is imperative to maintain its relevance and impact, which involves establishing credibility, transferability, dependability, and confirmability (Lincoln & Guba, 1985). These principles serve as foundational pillars that guides researchers in producing rigorous and reliable qualitative studies.

Credibility refers to the authenticity of the findings, ensuring they accurately reflect the studied phenomena, and enhancing the trust in research outcomes, which was achieved through prolonged involvement, persistent observation, and triangulation of data. In terms of transferability, it refers to the assessment of the relevance and applicability of findings across different settings, achieved through comprehensive and detailed explanations, thereby extending the research's impact (Lincoln & Guba, 1985).

Dependability, akin to reliability, relates to the consistency of the research process and its outcomes over time, which is achieved through clear documentation of the research process. Such transparency enables others to replicate the study and validate its conclusions, reinforcing the reliability and credibility of the research. And confirmability guarantees the objectivity by maintaining neutrality and transparency throughout the research, enhancing credibility, achieved through peer debriefing and member checking (Lincoln & Guba, 1985).

With a commitment to rigorous methodology, transparency and reflexivity, along with the adherence to these principles, researchers are able to enhance the trustworthiness and validity of the qualitative research findings, bolstering its contribution to knowledge and practice and influencing future research paths.

5 Empirical Research

Sample selection and data collection methods have a major impact on shaping the generalizability and reliability of research findings. This research utilizes non-probability sampling, more specifically purposive sampling, focusing on individuals with relevant expertise aligned with research objectives of developing and sustaining LLs. It includes two distinct data collection methods: interviewing KAMK RDI members with roles within LLs, to understand their current practices, and benchmarking them through collaborative workshops with ENHEIs partnering universities to obtain insights and best practices from them.

Interviews were selected for their ability to provide in-depth insights into complex topics, such as the development of LLs. To conduct the interviews, the researcher identified and approached individuals within KAMK RDI teams with active roles within the LLs, relevant to this research objectives. It was considered the role, expertise, and type of involvement in the practices under review. This method allows for rich data collection, flexibility, adaptability in questioning, and opportunities for clarification and exploration of responses, leading to a comprehensive evaluation and the co-creation of meaning (Saunders et al., 2016, pp. 388). By tapping into the firsthand experiences and insights of RDI team members, the researcher deepens the understanding of KAMK' labs.

The qualitative benchmarking is a valuable research method that collects data and gains insights into best practices, strategies, and approaches utilized by the partnering HEIs with similar objectives or challenges. Three HEIs from ENIHEI were selected due to well-established LLs. This process involves comparing and analyzing the performance, processes, and outcomes, identifying strengths, weaknesses, and opportunities for improvement. In the workshops, the HEIs were invited to openly collaborate in a dynamic session to exchange ideas, expertise, valuable experiences, and best practices, with a collaborative brainstorming session, aiding as a structured approach to guide discussion and exploration.

The selected dual approach exhibits a thorough strategy for gathering insights, whereby interviewing KAMK members, an insider's view on current practices is obtained, and by collaborative workshops with benchmarked HEIs, a wider and comparative perspective providing a set of best practices is attained. The researcher conducted a content analysis, to examine the data, aimed to extract meaningful interpretations, shed light on key issues and provide valuable insights into the subject matter under investigation by meticulously examining the content of the interviews and

workshops. It allowed for an exploration of the narratives and diverse perspectives shared by the participants, ultimately contributing to a deeper understanding of the phenomenon under study.

5.1 Interviews

The researcher conducted in-person interviews with five participants actively engaged in different RDI teams, in order to gain valuable insights into the current status of KAMK's RDI teams' practices within the HEI labs. A list of ten team members to interview was provided to the researcher by the commissioner, yet only five were interviewed.

Using the theoretical framework of this research, the questions were formulated and presented in a semi-structured format conducted in English. Each interview lasted approximately 45-55 minutes. To maintain confidentiality, all participants chose to remain anonymous and were identified as interviewees (1), (2), (3), (4), and (5). The interviews were conducted between October 9th, 2023, and November 20th, 2023.

The selection of a semi-structured interview format by the researcher enabled respondents to share their unbiased perspectives on the research objectives. Questions were designed to be flexible, allowing for follow-up questions as necessary. Secondary data obtained from literature sources such as articles and journals informed the development of these questions. This approach facilitated open expression of opinions by the interviewees. Table 4 describes the interview participants and the duration of the interviews.

Interviewee	Domain of lab (Industry)	Role	Duration
Interviewee 1	Sustainability and Circular-Economy	Senior R&D Expert	53 minutes 39 sec
Interviewee 2	AI Integration and Serious Games	Project Manager	44 minutes 10 sec
Interviewee 3	Technology, Digitalization and AI	Senior Business Adviser	56 minutes 46 sec
Interviewee 4	Data Management to AI, Academic	R&D Coordinator	1 hour 03 minutes
Interviewee 5	Business Development and Academia	RDI Coordinator	34 minutes 32 sec

Figure 9 Interviews details.

The questions focused on gaining a comprehensive understanding of how RDI activities are conducted within KAMK, with a focus on project objectives, stakeholder engagement, collaboration

with internal and external partners, student involvement, innovation culture, project impact, integration of real-world contexts, knowledge dissemination practices, practical impact of research outcomes and LL approach. During the discussion, notes were taken to describe each participant's view on the lab ecosystem and suggest areas for improvement. All interviews were recorded and transcribed verbatim.

5.2 Qualitative Benchmarking

As part of the ENIHEI project, benchmarking was undertaken to compare KAMK's labs with those of other partnering HEIs, aiming to enhance the analysis. The focus was directed towards examining how these universities develop and manage their LLs. Benchmarking stands out as a crucial process for organizations striving to boost their performance and competitiveness, by comparing practices and performance with leading counterparts to pinpoint areas for improvement and adopt superior strategies. In this study, qualitative benchmarking was selected, emphasizing the collection and analysis of non-numerical data regarding organizational processes, practices, and strategies, involving the facilitation of a collaborative workshop and the utilization of qualitative analysis techniques.

The researcher organized a collaborative workshop, "*Sharing Best Practices for Living Labs Development*", on March 14th, 2024. Invitations were extended to four HEIs, but only two participated in the workshop: The University of Ca'Foscari and the Technical University of Gabrovo.

The Ca'Foscari University of Venice' LL initiative is dedicated to addressing environmental and societal issues within Venice through innovation and sustainability. By collaborating with faculty, students, local government, and industry partners, their LL strives to develop pioneering solutions in climate change mitigation, cultural heritage preservation, and sustainable tourism. Their LL program leverages advanced technologies and community engagement strategies to create a more resilient and vibrant Venice for future generations. It also fosters a culture of entrepreneurship, sustainability, and innovation, providing students with opportunities to apply their knowledge in real-world contexts and contribute to the local community's welfare.

On the other hand, the Technical University of Gabrovo is known for its innovation and entrepreneurship. Its dynamic LL program provides a collaborative platform for students, researchers, and industry partners to prototype solutions to real-world challenges, thus fostering technological innovation and economic development. With 18 modern labs in its Technology Park, the

university conducts market-oriented research in areas like intelligent mechatronic systems and energy-saving technologies. Although their LL initiative is new, it aims to become a vital hub for innovation, driving regional development and positioning Gabrovo as a centre of technological excellence.

The selection of such HEIs was strategic, considering their diverse expertise, alignment with workshop themes, potential for collaboration, and representation of different contexts. By bringing these institutions together, the workshop facilitated cross-learning, identification of common challenges and success factors, and networking, enriching discussions on managing and advancing LLs across different settings.

The purpose of inviting multiple universities to the project was to encourage collaboration, diversity, and knowledge exchange within the academic community and among partnering HEIs within the ENIHEI project. The two HEIs showcased varying focuses on LL management and development, ranging from technological to societal innovation-oriented approaches. Ca' Foscari concentrates on Venice's environmental and societal issues, while Gabrovo's Technical University emphasizes technological innovation and entrepreneurship for regional development.

The qualitative data collection methodology involved benchmarking HEIs with two primary techniques: pre-requested questions presented in a structured format and facilitated discussions during workshop sessions. This multi-method approach was employed to ensure a comprehensive understanding of the subject matter under analysis. The workshop was facilitated by the researcher, held via Teams, and lasted two hours. Representatives from both HEIs exchanged insights regarding their LLs initiatives.

Following their presentation, both HEIs' representatives, along with a representative from the commissioner LL, collaborated in a brainstorming session focused on identifying the bottlenecks and facilitators crucial for the success of their respective LLs. Brainstorming is a collaborative technique used to generate creative ideas and solutions to challenges within a group setting. During a brainstorming session, participants are encouraged to express their thoughts freely and without inhibition. This open exchange of ideas facilitates the exploration of diverse perspectives and possibilities, often resulting in the emergence of innovative and unconventional solutions. By harnessing the collective knowledge and creativity of the group, brainstorming cultivates a rich tapestry of ideas, finding possibilities that might elude individual contemplation.

In January, another workshop was organized by the commissioner of this study, with representatives from the University of Malmo, Sweden in attendance. Their LL initiative is known for its

innovative approach to fostering sustainable urban development and social innovation. This HEI engages citizens, civil society, and public/private sectors by integrating participatory action research, design, and critical theories. By addressing urban challenges like mobility and sustainability, it fosters a culture of experimentation and collaboration. Through participatory design and action research, it empowers stakeholders to develop solutions, embodying principles of open innovation. Ultimately, their LLs act as a dynamic platform driving positive change and shaping the future of urban living.

To comprehensively gather information, the researcher employed data collection techniques, including notetaking during presentations, discussions, and interactive sessions to capture important points, insights, and participant feedback. For thorough analysis, both workshops were recorded to ensure precise documentation of all discussions and presentations.

Benchmarking these universities provided valuable insights for improvement. By comparing practices, the researcher identified areas of strength and potential enhancement, aimed to draw lessons from the successes, challenges, and best practices of these HEIs to enhance the effectiveness and impact of KAMK's LL initiative.

6 Data Analysis and Findings

6.1 Analysis of Current KAMK'RDI Practices

The researcher conducted a content analysis of the data employing abductive methods, which involves considering different explanations for what is observed, bolstered by the use of ATLAS software for data coding and pattern recognition, to manage and understand a large amount of data more effectively. Employing abduction methods allowed the researcher to analyze the data from different angles, considering various perspectives and explanations for observed patterns, while also considering the theoretical framework utilized in the study.

At its core, the analysis of interview data lies in its role as a starting point for investigating current practices within the KAMK labs. By highlighting these practices, this analysis helps guide efforts to assess the alignment of these practices with the principles of LL, exploring the enablers and barriers shaping the effectiveness of these practices and overall labs, and providing insight for improving efficacy and impact.

During the interviews, the participants were asked several questions about how their RDI teams operate while conducting projects within the KAMK innovation ecosystem. The questions covered topics such as project objectives, stakeholder engagement, collaboration with internal and external partners, student involvement, innovation culture, project impact, integration of real-world contexts, knowledge dissemination practices, practical impact of research outcomes, and LL approach.

After analyzing the data, five major themes emerged: Collaboration ecosystem, stakeholder empowerment, contextual relevance, impactful innovation, and resilience/longevity of the ecosystem.

6.1.1 Collaboration Ecosystem

Within this theme, all participants agreed that communication is vital for stakeholder engagement and diversity, facilitating collaboration and the innovation process. One participant stated that:

> "*The iterative-driven approach goes both ways. It's not just us doing something and asking for feedback; they also provide examples of what they've been doing in certain areas, and then we elaborate together on how to improve in the future. It's definitely an approach centered around active collaboration*."- Participant 1.

This was reinforced by another participant, who emphasized the importance of a two-way communication approach, as stakeholders are a fundamental building block when considering their innovation ecosystem:

> "*When we have stakeholders or customers, we try to make the communication kind of very direct, in a way that both parties are speaking. (…) When thinking of stakeholder engagement, this is something that should be very direct with us*." – Participant 2.

Other participants strengthened the importance of stakeholder engagement by expressing:

> "*I assume that communication and collaboration with stakeholders— whether regional players, educational institutes, companies from various sectors, or industrial partners—is essential.*" – Participant 3.

> "*Establishing good networks and partnerships remains key to the success of our projects (…) especially since we are business-driven*" – Participant 4.

Nevertheless, some of them mentioned that their level of involvement depends on the type of actor and the type of project, arguing that in order to differentiate themselves they do not aim to overload the stakeholders and companies involved in the project with additional workload to what they have. Yet, when it comes to the development process, stakeholders' involvement becomes substantial, if it's beneficial to them.

> "*As we move towards the use case or development phase, where the company or stakeholders can benefit or provide facilities for prototyping and testing, their involvement becomes heavier, possibly lasting up to half a year."* – Participant 2.

However, the collaboration ecosystem presents challenges such as knowledge sharing and a lack of expertise and resources, which influences the cross-pollination of ideas and the advancement of projects. This is mentioned:

> *“There are not enough resources to participate enough. Especially in the technology field, our teams are scattered, not working together, and it's rather hard to get information from different teams. There might even be barriers between the teams, even though we are residing within the same confidence area, which is unfortunate*.” – Participant 4.

Participants emphasized that this lack of knowledge transfer between teams can be due to “*some may feel threatened by sharing, fearing it may jeopardize their position*”, highlighting that individual professional growth is limited without collaboration, and the need to surround themselves with experts to thrive. All participants agreed that the shortage of skilled individuals is a significant bottleneck for operations optimization, and sharing knowledge will strengthen their collective capabilities.

> *“The main bottleneck is the shortage of skilled individuals (…) we are in constant lack of finding people with enough expertise. So, sharing knowledge will strengthen our collective capabilities and benefit everyone involved.*" – Participant 1.

> *“Finding the right people and experts can be hard (…) there are not enough viable resources and expertise to guide new funding, to provide those funds and applications, and we are suffering from that also. There are a few people who are very experienced in bright things, but we should all the time be able to introduce that skill to new people”*. – Participant 4.

Also, the connection between lack of expertise and student involvement was argued, which is either recognized to be lacking or not knowing how to involve them but aiming to improve, or that they are involved in the projects, at some point of the project. Usually involved as a trainee or in a thesis project, such challenge is justified by the lack of interest and unclear for student track:

> “*The level of involvement needs to be better, that's a problem for us. (…) we lack students here at KAMK who are interested (…) as I think that for most of them, it’s a bit unclear how will they benefit (…) unsure if they should participate in activities outside of their field.”* – Participant 1.

> “*Involving students depends on the project and student’s expertise (..) very few students (…) are involved in our projects. This is partly because most of our master's students are focused on their coursework, which isn't closely related to our work*

> *(…) We want to involve students because it benefits both parties, but we haven't been very successful in the past."* – Participant 5.

It is noted that sometimes the project topic of the RDI team aligns with the student course structure, where correspondent professors are involved, allowing them to involve their student group in the collaboration group.

During the discussion, one participant stressed how student involvement helps the team to advance their project faster. It was recognized the importance of involving and engaging students as stakeholders in projects, encouraging their participation, arguing that transferring the knowledge to students can increase the expertise needed in the projects and for real life. However, challenges arise when the project schedule does not align well with the academic calendar.

It was noted that there is a need for collaboration across fields within KAMK. They advocated for breaking barriers between those who focus on practical tasks and those who focus on academic work, promoting better interdisciplinary collaboration with these groups. This way, the projects can benefit from the expertise of both groups, leading to better projects.

6.1.2 Stakeholder Empowerment

Participants agreed that collaboration is a major factor when it comes to project success. It is noted that project ideas frequently originate from stakeholders, who often recognize the need for action or opportunity for improvement, or the need is identified on the market and brought to the stakeholder.

> "*Most project ideas come from stakeholders or a combination thereof, indicating a perceived need or opportunity for improvement. (…) We need to consider how to engage them, especially if the ideas emerge from ongoing collaboration where they identify bottlenecks or needs.*" – Participant 1

It is stressed the relationship between perceived need from stakeholders and involvement in the overall project life cycle.

> *"We refine ideas collaboratively before the formal proposal, ensuring stakeholder engagement in defining, writing, and shaping project objectives and content."* – Participant 1.

> *“We're actively consulting with companies to understand their specific (…) needs, starting from the planning process all the way to implementation (…) they are involved throughout the entire project. (…) We collaborate with stakeholders, end users, companies, and partners to plan project details”* – Participant 5.

Nonetheless, the level of involvement is mentioned as dependent on the type of project and its content. Such collaboration enables iterative problem-solving and co-creation with partners and users, which leads to the emphasis on feedback approach and real-world context. Users are frequently involved in the development process through data collection, feedback mechanisms, and testing.

> “*Most of our projects (…) involve how openly we interact with companies (…) Our experts and resources collaborate with the companies to solve their problems and come up with solutions. (…) We seek their opinions on areas needing further exploration, identify missing explanations, and their proposals for the next steps. Their involvement includes co-planning activities due to the project's collaborative nature."* – Participant 3.

The actors involved in this collaboration are the same for the five RDI teams, including industry partners, governmental entities/municipalities, educational institutions, and funders, which are considered crucial for the project's success.

> “*Regarding R&D projects, I believe the most effective approach is to involve companies, end-users, and stakeholders directly in the project*." – Participant 4.

One participant continued stressing that having strong contact networks and reliable partners is essential for refining and improving the ideas, technologies, and approaches. However,

> "*But I must highlight that the end user or stakeholder involvement should be much more frequent and systematic (…) which can be challenging as stakeholders are often busy, and the project's added value may not always be straightforward for them.”* – Participant 4.

6.1.3 Contextual Relevance

All teams agree that it is important to adopt a real-world context approach when it comes to developing and testing innovative solutions. This involves a commitment to accuracy and authenticity, mentioned by:

> *“When developing solutions for a company, we always focus on real-world examples and settings in the development process. (…) We base our projects on a thorough understanding of what is happening, to avoid misalignment with real-world needs.”* – Participant 3.

> *"All of our products are integrated into real life (…) working with them directly to understand their requirements, being clear that our work is closely tied to real-world activities."* – Participant 5.

This demonstrates a strong emphasis on practical application and relevance, prioritizing addressing tangible problems and needs within real-life contexts. One emphasized the importance of discussing project ideas with industries to measure interest and ensure value before seeking funding. This stresses the significance of industry collaboration and market relevance validation in driving project viability and success. One expressed:

> "*We not only discuss these issues with them but also provide support. We aim to encourage them to think about the future - what it holds, and what potential opportunities might arise. We don't just address current needs; we also strive to anticipate future ones and explore emerging possibilities*” – Participant 5.

Additionally, the teams adopt a feedback-driven approach to achieve early refinement. Understanding customer needs and market dynamics is crucial for developing impactful solutions.

> "*We try to test everything we do as early as possible with end users or customers. So, involving the customer in all phases of development is standard practice for us (…) (actively participate in designing the content).*" – Participant 3.

6.1.4 Impactful Innovation

Participants highlighted the value proposition for stakeholders, emphasizing the practicality and positive impact of their endeavours. Whether creating beneficial solutions, prioritizing local community interests, or fostering regional development through partnerships, the main goal is to obtain mutual benefits.

> "*We must prioritize our strategy; it's pointless to embark on a research project solely for financial gain. We need to get benefits for ourselves, our education, and our strategic goals. Additionally, we should ensure that the local community benefits, as we first operate at a regional level, with some national and international reach. However, we must prioritize the local community's interests and ensure they receive tangible benefits*" – Participant 4.

The focus lies on creating tangible value for all involved parties, aligning with strategic goals, and fostering ethical practices.

> "*If we want everything to work well together, everyone needs to play their part, having collaboration and real-time feedback between different project actors to ensure that the bigger picture is clear for all.*" – Participant 1.

> "*If we identify potential (value) (…), we conduct extensive (research) to assess their impact and identify stakeholders or beneficiaries. This process is essential in turning innovations into viable products. We evaluate whether it's best suited for startup creation, spin-off, or if it's suitable for sale to existing companies. We go through all these processes meticulously*" – Participant 3.

In terms of dissemination of findings, participants vary in their approach, with some requiring it due to funding requirements or having a more limited approach.

> "*It's highly encouraged, especially if we're undertaking projects with national or regional funding, being often our main funding sources. The free and open sharing of information is a necessary part of the project*" – Participant 4.

> "*The dissemination is more limited, but now we have at least opened up a little bit (sharing on online platforms) (…) I ensure that everything we do is beneficial and*

> *practical. We're not solely engaged in academic research; we must always consider how to apply and commercialize our findings*." – Participant 5.

Participants stressed the need for improved guidance and clear instructions for further development and commercialization. However, they all agree on the importance of practicality, ethical conduct, and broad dissemination across various communication channels to ensure transparency and maximize impact. They follow both KAMK and funders' guidelines of ethical considerations.

> "*We ensure that everything we produce is highly practical in nature. (…) and try to make everything we create available in some form (…) But, when it comes to obtaining company backing for further development, the process isn't always clear (…) lack of clear instructions on how to proceed, particularly if it comes out of our R&D labs and that is something companies could improve*." – Participant 2.

6.1.5 Resilience/Longevity of the Ecosystem

Participants employ a variety of processes and strategies to achieve their goals. Some prioritize exploration and testing to find optimal solutions, guided by strategic objectives at various levels, while others emphasize flexibility in management methods depending on the project type and scope. Regardless of these differences, all participants aim to align their strategies with broader visions, whether it's enhancing business interests or educational goals. The key to success lies in the dynamic relationship between exploration, alignment, and strategic decision-making.

However, one participant highlighted that there is a need to clarify the project's strategies to all members, especially those starting.

> "*One component that should be improved is ensuring that even project workers who have just started are familiar with our R&D strategy. They should understand the main areas of focus and what they need to do next in terms of activities. Our steps to achieve the strategic goals must be very clear. This is crucial for the success of the project."* – Participant 4.

Moreover, funding is a major factor that affects decision-making for all participants. Some argue that funding is the primary reason for selecting a project, either public or private. However,

funding can also be a bottleneck in terms of applying for funding or how it is controlled by the administration.

> "*I will still say that available funding is still kind of a large factor in our decisions. We need to prioritize our direction based on available funding, as our projects are entirely project-based. (…) Funding considerations can sometimes be challenging as we need substantial resources*" – Participant 2.

> "*It can be slightly challenging because the administration is controlling a bit of the funding side (…) This often drives teams to operate more like a company, to make money and more service sales projects. But this is complicated when teams sometimes don't have the tools that companies have, so it makes the development slightly more challenging."* – Participant 2.

Despite these challenges, participants acknowledge the availability of some funding programs supporting project initiatives, albeit with expectations of active engagement in dissemination activities.

In terms of operational settings, teams tend to blend physical and digital elements for their operations. While most participants believe that physical settings are essential for enhanced communication and collaboration, as well as providing a place for the necessary equipment, virtual environments are recognized for their flexibility and potential to accommodate remote collaboration.

In addition, innovation and creativity culture emerged as a key code. Participants recognized the need to balance structured frameworks with autonomy to encourage innovative thinking. Intrinsic motivation and collaboration are identified as key drivers of innovation and creativity. However, challenges such as time constraints and workload management are acknowledged as potential barriers to fostering a culture of innovation, justifying that if there were unlimited resources and funding, the situation would be different.

> "*If everyone is busy all the time, it kills innovation and creativity. For example, I have struggled with this issue for many years, I'm not creative at all because I don't have time to be."* – Participant 4.

> *"About culture of innovation, it depends on the project manager."* – Participant 5.

Moreover, ensuring the sustainability of RDI projects beyond their initial phases is identified as a significant challenge. Participants express concerns regarding the discontinuation of project

activities following the conclusion of funding cycles, emphasizing the importance of long-term planning and stakeholder engagement to sustain project outcomes. Strategies such as seeking sponsorship from local entities and fostering partnerships are proposed to address sustainability challenges and promote the continuity of R&D initiatives.

Furthermore, the researcher questioned the living lab approach, finding that participants were familiar with the phenomena. Interestingly, they observed that certain aspects of their operations closely resembled those of living labs, albeit some of them without explicitly recognizing their own setups as such. This highlights the necessity of clarifying the living lab concept and offering a concise definition applicable to all lab settings.

> "*Our projects often resemble a living lab experience, where we conduct parallel testing of different solutions in both controlled laboratory settings and real-world environments. This approach accelerates the development process by enabling us to quickly identify what works and what doesn't*". – Participant 1.

One recognized that coordination among stakeholders and sustained commitment are required for maintaining the viability of LL initiatives, and thus, the need to establish systematic approaches and structures to facilitate ongoing engagement and development.

> "*In traditional research and innovation practice, which we are conducting here mainly, R&D teams may reside in the same building (…) facilities to collaborate with students, teachers, maybe companies, and those governmental players, when necessary, and a steering board. But it's not as open, free, and innovative approach as living labs (…) But it should be coordinated, and there should be a promise that it will continue in the future and that in itself can be a little uncertain."*– Participant 4

In essence, they are advocating for a strategic and sustainable framework to fully leverage the potential of LLs in driving innovation and addressing complex societal challenges over time.

6.1.6 Results

The purpose of the interviews aimed to assess whether the current operations of the KAMK RDI team align with the principles of LL (Q1). The principles of LL are openness, influence, realism, value, and sustainability (Bergvall-Kåreborn et al., 2009; Ståhlbröst, 2012, pp. 63–67). The

identified themes and codes within primary data exhibit a significant alignment with the key principles of LL (Table 5).

Key principle	Identified Theme	Identified Codes	Observation by the researcher (Noted on the studied HEI).	
Openness	Collaboration Ecosystem	- Stakeholder - engagement/diversity - Participation levels - of students - Knowledge sharing - Expertise - Interdisciplinary - collaboration/ accessibility of resources	The identified theme and codes directly align with the principle of Openness – Emphasis on creating an environment that fosters collaboration among diverse stakeholders. This is observed in the case of HEI.	- Encourages involvement from different stakeholders. - Aims to engage students, fostering a culture of learning and knowledge exchange – Needs improvement. - Understand the importance of sharing information and knowledge but act as a bottleneck. - Leveraging existing diverse expertise for collaborative problem-solving, yet deficient. - Encouraging collaboration within teams but operating in silos.
Influence	Stakeholder empowerment	- Recognizing and collaborating with relevant stakeholders/ Perceived needs by stakeholders - Co-creation/Iterative collaboration with partners/collaborative problem-solving - User involvement - Actors - Stakeholder engagement	Stressing the importance of recognizing stakeholders' needs and enabling them in the co-creation process.	- Commitment to understanding stakeholders' perspectives and involving them in decision-making processes. - Iterative collaboration and co-creation with stakeholders. - Involvement of stakeholders with influence on the project outcomes.
Realism	Contextual relevance	- Real-life context - Early refinement based on user/customer feedback. - Feedback-driven approach - Industry relevance	Point out the importance of grounding projects in real-world contexts.	- Prioritizing early feedback and ensuring projects that tackle real-world challenges with industry relevance.
Value	Impactful innovation	- Project diversity - Perceived value proposition for all participants and stakeholders - Dissemination of results - Ethical considerations	Focus on delivering tangible benefits and value to participants and stakeholders.	- Engaged in diverse projects, following ethical considerations, and disseminating results for maximum impact. - Perceive the value to all participants and projects are driven by feedback to maximize impact.
Sustainability	Resilient/ Longevity Ecosystem	- Governance structure - Funding - Settings - Innovation culture	Emphasizing the need for a robust ecosystem to sustain Living Lab initiatives.	- Significant bottlenecks are encountered concerning governance, funding, and nurturing a culture of innovation, to ensure the longevity of labs.

Figure 10 Relation of key principles of LL and themes identified in this study.

The identified themes and codes show strong alignment with the key principles of LL. However, it is important to acknowledge that variations exist among the studied teams. Differences exist in several aspects, such as the degree of student involvement, approaches to knowledge sharing, levels of expertise mobilized, strategies for dissemination of results, and unique considerations or views regarding their respective lab environments.

Hadfield et al., p. (2023, p. 6) view university living labs as facilitators of experimentation, but they also introduce organizational complexities that require a deeper understanding of institutionalization and governance. Challenges, such as governance structures, funding limitations, siloed institutional cultures, and limited participation, hinder their effectiveness. These challenges were observed in KAMK RDI labs.

Based on the authors' enablers of effective university LL governance, and as illustrated in figure 3, the analysis was made of KAMK's current RDI teams (Table 6).

Flexible coordination	- Stakeholder involvement and engagement are evident and highly valued in the projects – project-based cooperation. - Highlighted the need to clarify the vision and objectives of projects to all members as essential. - Accessibility of resources, including expertise, personnel allocation, and student involvement, is identified as a challenge. - Inclusive and participatory decision-making processes, to align vision and mobilize activities among all involved parties.
Investment	- Challenges exist in allocating funding for the governance framework and overall projects. - Investment in personnel and key systems poses challenges to the continuity and expansion of initiatives, especially in terms of continuous coordination
Facilitation	- The importance of building and nurturing relationships, both internally and externally is emphasized; Yet, while external collaboration is prioritized, internal relationship-building appears in an area in need of improvement, seen as barrier hindering effective collaboration and knowledge sharing among siloed teams and cross-functional collaboration. This is affected by amount of workload, time constraints, conflicting priorities and lack of understanding of each other's roles and responsibilities. As a result, the likelihood of duplicated efforts or a slower progress towards common goas is higher. - While interpersonal trust exists within teams, there is a recognized need for improvement among different teams. - In some teams, an environment that fosters innovation and creativity is evident, whereas in others, it tends to be neglected, often because of excessive workloads and tight time constraints. The focus of these teams tends to be primarily on meeting deadlines and addressing immediate tasks, leaving little or no room for exploration or experimentation. As a result, this may suppress creative thinking and lead to missed opportunities for innovation. - Need to deepen the culture of openness and cooperation among KAMK teams. Currently, this is lacking due to a shortage of time, expertise and excessive workload, which prevents teams from being more open and cooperative. Additionally, it is mentioned a lack of time for creativity and team engagement. Managing this can lead to better knowledge sharing and increase the development of expertise within the organization, which are essential need for the teams. - Different methodologies are utilized by the teams, resulting in a lack of uniformity in approaches across projects, based on the nature of such at hand. This variability can hinder collaboration and knowledge sharing, as each team operates independently with their chosen methods. Consequently, transferring best practices between projects becomes difficult, limiting the organization's ability to leverage past experiences effectively.
Communication	- Sharing knowledge within teams presents challenges, as insights and best practices are often being confined within specific departments. - Regular team meetings with open communication. - Valorisation of having a clear value proposition is observed and impactful projects with tangible benefits, where KAMK, stakeholders, and the community are beneficiaries. - Multi-level communication within teams and partners, with participants emphasizing as key to project success.

Figure 11 KAMK RDI lab's enablers of effective university LL governance.

Furthermore, according to Berberi et al., pp. (2023, pp. 8–11), certain factors can either enable or hinder the effectiveness and success of LL. The authors identified iterative processes, collaboration and partnerships, and networks as the most common enablers, while technology issues, time and cost of collaboration, and lack of sustainability were identified as the main barriers. When analyzing the current status of KAMK RDI teams, it was found that iterative processes are valuable for data collection and feedback, which aid in informed decision-making and the continuation of a project (*Enabler*).

In terms of collaborative approaches, such as co-creation and interdisciplinary collaboration, both among teams and with partners and users, were identified as *enablers*. Partnerships and networks, which involve developing social activities for communication, informal interactions, and network opportunities, were also considered *enablers.* However, it was observed that there is a lack of informal interactions due to time constraints and workload.

Technology availability is considered an *enabler* due to its availability, but it was noted that the lack of certain technologies can hinder the progress of some projects. Time and cost constraints are the main identified *barriers* to collaboration, as there can be mismatches between the capacity of the LL partners and the expected outcomes of the partnership, leading to increased workload.

The sustainability of labs was found to be a significant *barrier*, as there is a lack of resources and competencies to the RDI team's processes and outcomes beyond the project and to transfer innovation to the real world. Motivation among participants throughout the process needs to be continuously nurtured and sustained, especially within teams over time (*Enabler/barrier*).

It is important to note that each enabler and barrier has an interplay approach, depending on their execution and implementation quality. Barriers can often be turned into enablers and vice versa, but the quality or level at which the practice was mobilized determines whether it was an enabler or a barrier (Berberi et al., 2023, p. 10).

Last, KAMK RDI labs currently follow a provider-driven approach, in which the institution plays a key role as the primary resource for infrastructure, expertise, and other necessary resources. The labs lead innovation efforts by collaborating with various stakeholders. Additionally, the studied HEI is embedded in a cross-border LL network, where the RDI teams collaborate with international universities, development organizations, and companies, expanding opportunities for collaboration, innovation, and knowledge exchange across different geographical regions.

6.2 Collaborative Workshops – Benchmarking HEIs

Two collaborative workshops were organized to gather insights from HEIs involved in LL initiatives, Ca'Foscari University of Venice, Technical University of Gabrovo, and the University of Malmo, both by the researcher and commissioner project representatives. Such an initiative was designed to facilitate open discussions, brainstorming sessions, and knowledge sharing among participants. The format included presentations from representatives of each university followed by interactive sessions where participants could ask questions and share experiences.

The workshop participants consisted of key representatives involved in the management and development of LL initiatives from their respective universities, selected based on their expertise and involvement in such initiatives, ensuring diverse perspectives and insights.

Collected data underwent qualitative analysis to identify key themes, patterns, and insights. This analysis involved a thematic analysis to identify recurring themes and topics discussed by participants and a comparative analysis was conducted to compare the LL initiatives across benchmarked universities, focusing on similarities, differences, strengths, and areas for improvement.

The selection of the Ca'Foscari University of Venice, Technical University of Gabrovo, and University of Malmo as benchmarked universities was based on the diverse approaches to managing and developing LL initiatives, including interdisciplinary collaboration, market-oriented research, and community-centered innovation. The benchmarked universities are located in different regions, providing insights into the management and development of LL in diverse geographical contexts. Additionally, each LL initiatives align with the research focus and objectives of the study, ensuring the relevance of the data collected.

The criteria used for comparison included educational focus, highlighting interdisciplinary collaboration, innovation management, and community engagement within LL initiatives; approaches to involving diverse stakeholders such as students, academic staff, industry partners, and local authorities, strategies for securing funding and resources to sustain their LL initiatives, organizational structure, and identification of common challenges faced and enablers of success across the benchmarked universities.

6.2.1 Ca'Foscari University of Venice – Living Lab Initiative

This HEI strongly commits to interdisciplinary collaboration, innovation, and community engagement. Its organizational structure is clearly defined, assigning roles to faculty, project managers, consultants, and tutors. Challenges concerning funding, space, and transitioning from ideation to implementation were acknowledged, indicating areas for improvement. The adoption of methodologies like design thinking and project-based learning mirrors current educational trends. Initiatives such as cross-country lab experiences show a dedication to broadening the program's influence. Table 7 showcase the summarised analysis on Ca'Foscari University of Venice LL' initiative.

Management and Development of LL	– Emphasis on interdisciplinary collaboration by bringing together students, faculty, researchers, professionals, and external stakeholders from diverse backgrounds for active deductive collaboration. – Employ a new learning model that bridges the gap between academia, the economy, and society, exploring innovative ways of sharing academic knowledge, fostering collaboration, and promoting a new mindset beyond university walls. – Clear organizational structure, with the presence of a steering committee, project manager, faculty members, methodology consultants, and tutors to ensure effective management and coordination of activities within the LL, primarily targeting students from high school to Ph.D. levels, collaborating with companies and institutions. – Follow a structured program design, including interdisciplinary lectures, stakeholder engagement, teaching methodologies, and presentation skills development, enriching the learning experience. Integration of design thinking and project-based learning to foster inclusivity and student innovation, aligning with modern educational trends, and enhancing problem-solving skills and creativity. – Employs a student-centric approach, where students are empowered to work autonomously, express creativity, and advise their communities, fostering entrepreneurship and self-responsibility. Encouraged to embrace their roles as protagonists reflect the essence of these labs from their perspective. – Active community engagement, involving external stakeholders from businesses, museums, and other cultural activities, enriching the learning experience and strengthening the connection between academia, economy, and society, aiming to bridge them by sharing academic knowledge beyond university walls and promoting a new mindset.
Bottlenecks to Achieve Success	– Limited funding impedes the sustainability of external advisors and acquiring a permanent physical space. – Resource limitations and expertise gaps hinder the transition from ideation to implementation during the acceleration phase. – Engaging participants from diverse fields such as sciences and social sciences – Gap in expertise for teaching methodologies like design thinking reflect systemic issues within the university system.

	– University staff to take on additional projects can be difficult due to existing workload constraints, even with financial incentives. – Lack of a permanent physical space hampers program continuity and operational efficiency, aiming to establish a permanent team structure. – Balancing various responsibilities such as research, teaching, assessments, and project management is a significant challenge for university staff.
Best Practices	– Promote interdisciplinary collaboration to foster creativity, innovation, and holistic problem-solving approaches, through arranged interdisciplinary lectures aimed at establishing a shared knowledge foundation among participants. – Actively engaging external stakeholders from industry, culture, and society enriches learning experiences, fosters real-world relevance, and strengthens community connections. – Implemented a structured program design with clear objectives, milestones, and learning outcomes to enhance program effectiveness and participant engagement. – A culture of continuous improvement through feedback mechanisms, evaluation, and adaptation ensures ongoing relevance and impact. – The deep involvement of university staff energizes projects and enhances success, especially when ideas originate within the academic community and are executed with students, who learn various social analysis methodologies relevant to the professional world.

Figure 12 Summarized analysis on LL' initiative of Ca'Foscari University of Venice.

6.2.2 Technical University of Gabrovo – Living Lab Initiative

This institution emphasizes its role as an educational hub, accessible to various stakeholders, focusing on market-oriented research to meet engineering demands and advance industrial solutions. Despite facing challenges like budget constraints and limited faculty support, its LLs aim to become leading European centers in engineering. Best practices, including industry collaboration and innovation culture, offer avenues to overcome obstacles and drive LLs toward sustainable growth and impactful contributions to academia and industry. Table 8 reflects on the summarized key points of the Technical University of Gabrovo LL's initiative.

Management and Development of LL	– Educational focus, viewing LL as open laboratories accessible to students, businesses, and the non-governmental sector, primarily focusing on market-oriented research in collaboration with companies or municipalities. – Aiming to meet societal demand for engineering professionals and advance research for industrial benefit, it seeks to establish itself as a leading European research center in engineering and energy-saving solutions. – Technology Park serves as LL settings, where stakeholders collaborate to develop solutions in response to local needs and aims for human resource development,

	connecting with local companies, building scientific capacity, and fostering research commercialization with businesses. – Stakeholder engagement, including local enterprises, regional governments, and young talents seeking opportunities for innovation, without providing funding. – Students, PhD candidates, and researchers are essential to their LL initiatives, actively engaging in community-driven projects and receiving practical training in the tech park's real working environment.
Bottlenecks to Achieve Success	– Limited budget constraints challenge sustaining the living lab and attracting stakeholders, requiring funding from Bulgarian and European programs. – Administrative burden and transient nature of research positions. – Attracting and retaining students is challenging, as many prefer international opportunities. – Lack of a dedicated unit responsible for the LL or technology park, relying on the voluntary efforts of university professors, indicating a need for better coordination and leadership. – Some professors do not support activities due to a lack of direct benefits. – Limited visibility and recognition beyond historical roles as a small city in Bulgaria hampers attracting students, entrepreneurs, and local authorities, necessitating stronger branding and outreach. – Companies often present complex problems, and equipment limitations may impede solutions. – Inconsistent municipal engagement requires alternative project development, with sporadic proposals.
Best Practices	– Collaborate closely with industry and businesses to address their specific needs effectively enhancing the relevance and impact of research and educational initiatives. – Retaining qualified Bulgarian researchers and specialists, by fostering a culture of innovation, and building good university-industry partnerships. – Shifting towards a new educational approach where universities are responsible for providing practical training and conducting applied research for the industry in alignment with industry demands and enhancing students' employability. – Student engagement beyond academics is encouraged, offering opportunities for voluntary involvement in ongoing projects. – Collaborating with institutions like the Bulgarian Academy of Sciences strengthens research capabilities and fosters innovation. – Diversified funding sources, relying on securing funds through various projects to provide quality educational services and support research endeavours. – Selling outcomes from research through patent development and promotion of useful models has been successful, especially in collaborative projects with international partners.

Figure 13 Summarized analysis on LL' initiative of the Technical University of Gabrovo.

6.2.3 Comparison of HEIs LL' Initiatives

The Ca'Foscari University of Venice and the Technical University of Gabrovo share common goals of promoting interdisciplinary collaboration and fostering innovation, yet they differ in their educational focus, stakeholder engagement model, funding sources, and organizational structure. These differences reflect their unique approaches to addressing local needs and advancing research and education in their respective contexts, which can be observed in table 9.

Differences		
	University of Venice	**University of Gabrovo**
Educational focus	Emphasize promoting a culture of entrepreneurship, sustainability, and innovation through interdisciplinary collaboration among students, researchers, and professionals.	Focus on market-oriented research in engineering and energy-saving solutions, primarily in collaboration with businesses or municipalities.
Stakeholder engagement (While both universities engage stakeholders, their roles and contributions differ)	Collaborates with external stakeholders, including businesses and cultural institutions, to provide funding, guidance, and real-world challenges for students.	Relies on stakeholders primarily for problem identification and solution validation, without financial contributions.
Funding model	Relies on a combination of university funds, external sponsorships, and private partnerships, including financial support from stakeholders.	Secures funding primarily through Bulgarian and European programs, with minimal financial involvement from stakeholders.
Organizational Structure	Has a dedicated team, including a steering committee, project manager, faculty members, and methodology consultants, responsible for designing and implementing the labs.	Lacks a dedicated unit for the living lab, relying on voluntary efforts from university professors and researchers.
Similarities		
Interdisciplinary collaboration among students, researchers, and professionals from various fields. They aim to bridge the gap between academia, industry, and society by fostering collaboration across disciplines to address real-world challenges.		
Provide practical training opportunities for students to apply theoretical knowledge in real-world contexts. Students engage in hands-on projects, collaborate with stakeholders, and develop solutions to address societal needs or industry challenges.		
Collaboration with industry partners to address practical challenges and promote innovation. They provide platforms for students to work on projects commissioned by companies, gain industry exposure, and develop skills relevant to the workforce.		

Prioritize innovation and entrepreneurship, aiming to foster a culture of innovation among students and empower them to develop solutions for societal and economic development. However, innovation efforts often rely on a small group of individuals, leading to an imbalance in driving change within the institution. Calls for blending traditional lecture formats with interactive, lab-like approaches to teaching to foster innovation and engagement. Yet, implementing innovative teaching methods requires additional resources, posing challenges for sustainability and scalability.
Recognize the need for systemic changes within the university system to prioritize and integrate innovative teaching methods as a core component of education, ultimately driving societal innovation.

Figure 14 Comparison of benchmarked HEIs.

Based on the brainstorming collaborative activity, between both universities and KAMK, it was possible to analyze the key points discussed regarding the barriers and enablers contributing to the success of their respective university LLs:

Barriers:

- Complexity of problems presented by companies requiring specialized expertise or equipment.
- Challenges in convincing colleagues (professors and students) to take on additional projects, in addition to other university responsibilities, even with financial incentives. This lack of active participation from academic staff leads to challenges in obtaining the necessary expertise and guidance.
- Workload management in addition to other university responsibilities, can be burdensome and unsustainable in the long term.
- Limited engagement from companies, where some may struggle to commit personnel to assist students with projects, hindering the quality and effectiveness of student-led initiatives.

Enablers:

- Active involvement of academic staff from idea generation to implementation, nurturing commitment, and energy within the academic community.
- Adopting a collaborative approach where university staff and stakeholders work together to identify and address real-world challenges leading to more impactful projects.
- Providing motivation and learning opportunities for students by solving real-world problems and developing critical thinking and problem-solving skills.

- Finding a balance between innovation and workload management.

- Creating a space for freedom and openness to new ideas, allowing students to think creatively and propose innovative solutions, and fostering creativity and collaboration among students, researchers, and industry partners.

- Incorporating strategic thinking into practical work and viewing projects as developmental endeavours, as incorporating strategic thinking into project development helps universities and companies navigate complex problems, adapt to changing circumstances, and embrace open-ended, developmental projects.

- Implementing systems for project proposal review and scheduling helps manage expectations, prevent project overload, and ensure effective planning and preparation.

With a few challenges in managing LLs, active involvement from academic staff, strategic planning, student motivation, and openness to innovation are key enablers contributing to their initiatives' success. Balancing workload, sustainability, and effective collaboration with companies are considered areas for improvement to ensure the continued growth and impact of university LLs.

6.2.4 University of Malmo – Living Lab Initiative

This HEI prioritizes real-world research and interdisciplinary collaboration to address societal challenges. Nevertheless, dependence on funding, and resistance to new approaches pose obstacles. Best practices include citizen engagement, cross-sector collaboration, and iterative design processes. Its LLs aim to empower stakeholders, foster innovation culture, and create inclusive spaces for collaborative innovation based on principles of agonism and hegemony. Table 10 summarizes the University of Malmo LL' initiative.

Management and Development of LL	– Emphasize conducting research and innovation in real-world environments, prioritizing citizen engagement and long-term perspectives. – Focus on Interdisciplinary collaboration with diverse stakeholders from academia, public, private, and non-profit sectors to address complex societal challenges. Aim for heterogeneity by involving diverse participants, actors, and perspectives. – Foster social sustainability, transformation, innovation, and entrepreneurship by implementing new ideas, products, services, and models to address social needs. – Adopted a radical stance on openness and community-centered approaches.

	– Utilize knowledge sharing platforms and collaboration hubs to facilitate cross-sectoral collaboration and broaden perspectives. – Implement research-based methodologies to enhance and foster collaboration in various ways. – Promote student engagement, allowing them to play active roles in co-creating innovative solutions and addressing societal challenges. – Integrate living lab projects into academic programs, enabling students to gain practical experience while earning academic credit.
Bottlenecks to Achieve Success	– Dependence on grants and funding challenges in sustaining LL initiatives over the long term. – Engaging diverse stakeholders from academia, government, industry, and civil society requires effective communication, coordination, and collaboration, which can be challenging to achieve. – Resource constraints, including financial, human, and infrastructural resources, may hinder the implementation and scalability of living lab projects. – Resistance to adopting new approaches, especially among established institutions and stakeholders, can impede the progress of living lab initiatives. – Student engagement varies in course curriculum, with differing levels of interest and impact. However, making it mandatory has proven beneficial for learning.
Best Practices	– Cross-sectoral collaboration and knowledge sharing through platforms like the Forum for Social Innovation promotes innovation and addresses complex societal challenges effectively. – Using the coalition method, facilitating rapid, interactive workshops to foster collaboration on new projects across various societal sectors. – Long-term perspective and focusing on sustained efforts enhancing the impact and effectiveness of LLs. – Prioritizing citizen engagement and community-centered approaches to ensure that solutions are co-created with those directly affected by them, leading to greater acceptance and adoption. – Democratizing the innovation process, ensuring all stakeholders, including workers, have a say. – Follow concepts of “things” implies objects or entities influencing social interactions, and “"publics" denotes groups formed around shared interests via digital platforms. Both concepts profoundly shaped the HEI's perspective. – Adopt an iterative design and experimentation process, allowing for continuous improvement and adaptation of projects based on feedback and insights gained from real-world implementation. – Participatory design approach incorporating diverse perspectives and skills into the innovation process. – Innovation culture within the organization and among stakeholders encourages experimentation, risk-taking, and continuous learning. – Invest in capacity-building initiatives, such as training programs and workshops, to empower stakeholders to actively participate in LL activities and contribute to the co-creation of solutions. – Recognizing and addressing diverse perspectives within infrastructure design (Physical infrastructure required within the lab and also to the infrastructure necessary for various technical solutions. importance of recognizing and addressing diverse perspectives and needs within infrastructure design and implementation).

	– Maintaining an open and flexible approach to collaboration, allowing for diverse perspectives, and being receptive to new ideas and feedback. – Creating agonistic spaces allows individuals with different views to engage respectfully. – Operates with guiding principles based on the concepts of agonism and hegemony, which involve understanding power dynamics and the prevailing system of values within society.

Figure 15 Summarized analysis of LL's initiative of the University of Malmo.

6.2.5 Benchmarking Conclusions

According to data from Ca'Foscari University of Venice, University of Gabrovo, and Malmo University, each institution has taken a unique approach to its LL initiatives. These approaches are tailored to the distinct contexts, goals, and stakeholder needs of each university. For instance, the Ca'Foscari University of Venice emphasizes collaboration with academic staff and student involvement, the University of Gabrovo focuses on motivation and overcoming barriers to participation, while Malmo University prioritizes interdisciplinary research, societal engagement, and infrastructure development within its living lab framework.

Despite differences, all three universities share common objectives in their LL initiatives, including nurturing innovation, promoting interdisciplinary collaboration, and enhancing stakeholder engagement, along with a clear emphasis on community impact in taken approaches.

Stakeholder engagement emerged as a major success factor as highlighted by the experiences of all three universities. Effective collaboration with diverse stakeholders, including academia, industry, government, and civil society, augments the co-creation process, enhances project outcomes, and ensures real-world relevance. This emphasis on stakeholder engagement underscores the importance of involving various voices and perspectives in the development and implementation of LL projects.

Additionally, student involvement was identified as a key component of LL initiatives at all three universities, highlighting that engaging students in practical learning experiences, interdisciplinary projects, and real-world challenges boosts their academic journey and contribute to the success and sustainability of such projects. By empowering students to take an active role in the co-creation process, universities can tap into their creativity, enthusiasm, and fresh perspectives.

While each university faces unique challenges in implementing and managing projects within their LL, such as resource constraints, workload pressures, and stakeholder coordination, they also identified enablers that contribute to overcoming these challenges, such as active stakeholder involvement, flexible project management, and innovation culture. These facilitate the success and sustainability of LL initiatives in the face of challenges.

The insights and experiences of these HEIs offered valuable lessons for designing, implementing, and managing LL initiatives. By leveraging these insights and addressing the challenges identified, institutions like KAMK can enhance the effectiveness, impact, and sustainability of their LL initiatives.

6.3 Development Task – Improved LL Model for KAMK

The researcher observed a need to optimize the development and enhancement of KAMK's LLs, which are vital for advancing research, innovation, and regional development within the Kainuu region. By improving the current LL model, the institution aims to boost collaborative research, open innovation, student involvement, and knowledge sharing within its ecosystem and with external partners. This will contribute to a sustainable future of the labs and positive change in the region. Additionally, it includes strategic recommendations to improve their functionality and effectiveness, drawing from best practices of analyzed HEIs.

It is important to note that this model was developed through a co-creation process with the commissioner representative. Figure 5 represents an overview of the KAMK ecosystem.

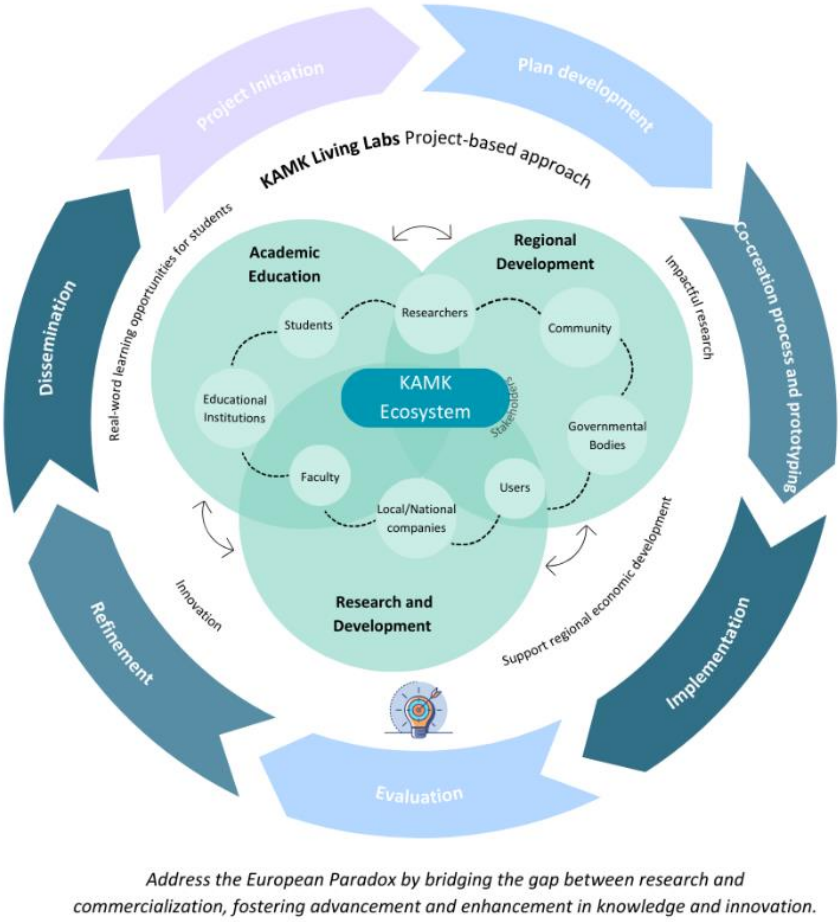

Figure 16 Current overview of KAMK ecosystem and LL approach.

The figure illustrates the holistic view of KAMK's ecosystem and LLs approach, which are centred around three core areas: academic education, regional development, and research and development. These components bring together a diverse group of stakeholders, including students, educational institutions, researchers, faculty, local and national companies, community members, governmental bodies, and end users, all of whom play significant roles within the LLs' context. Such areas are interconnected and interdependent, with growth in one area benefiting the others. This synergy drives the creation and operations within the institution LLs, which adopt a project-based approach to foster innovation, offer practical learning experiences for students, conduct impactful research, and support regional economic development.

With this, KAMK's LLs aim to bridge the gap between research and commercialization, addressing the "European paradox" – the discrepancy between high research output and low commercialization rates. This approach allows the institution to promote the advancement and enhancement of knowledge and innovation within the region and among stakeholders. It aids industry partners in developing, testing, and commercializing products more efficiently, reducing time-to-market.

For students, it provides hands-on learning experiences and skill development in real-world settings, whereas for faculty and researchers, they gain practical research opportunities and collaborations with industry and government. The region benefits from economic growth, community engagement, attraction of talent, and support for sustainable development.

The RDI projects approach encompasses a coordinated, iterative process designed to leverage on real-world testing and feedback to develop their innovations. The projects are initiated by the identification of a problem or opportunity and gathering stakeholders to form a project team. This is followed by creating a detailed project plan, outlining goals, resources needed, and timelines. The co-creation process then engages stakeholders in the development of potential solutions and generates prototypes for testing and refinement. During the implementation process, proposed solutions are put into action and their impact is monitored, followed by the assessment of the outcomes to determine their effectiveness, and adjustments are made based on evaluation feedback. Lastly, results and findings are shared with stakeholders, the community, and interested parties.

Nevertheless, after the previous analysis, the researcher observed several key points that the institution and its ecosystem need to prioritize in order to strategically develop and enhance its LL, as illustrated in Figure 6, which prioritizes actions based on importance and timeline. The recommendations aim to strengthen KAMK competitive position and attract adept students, faculty, and research partners, positioning the institution as a dynamic hub for innovation in higher education.

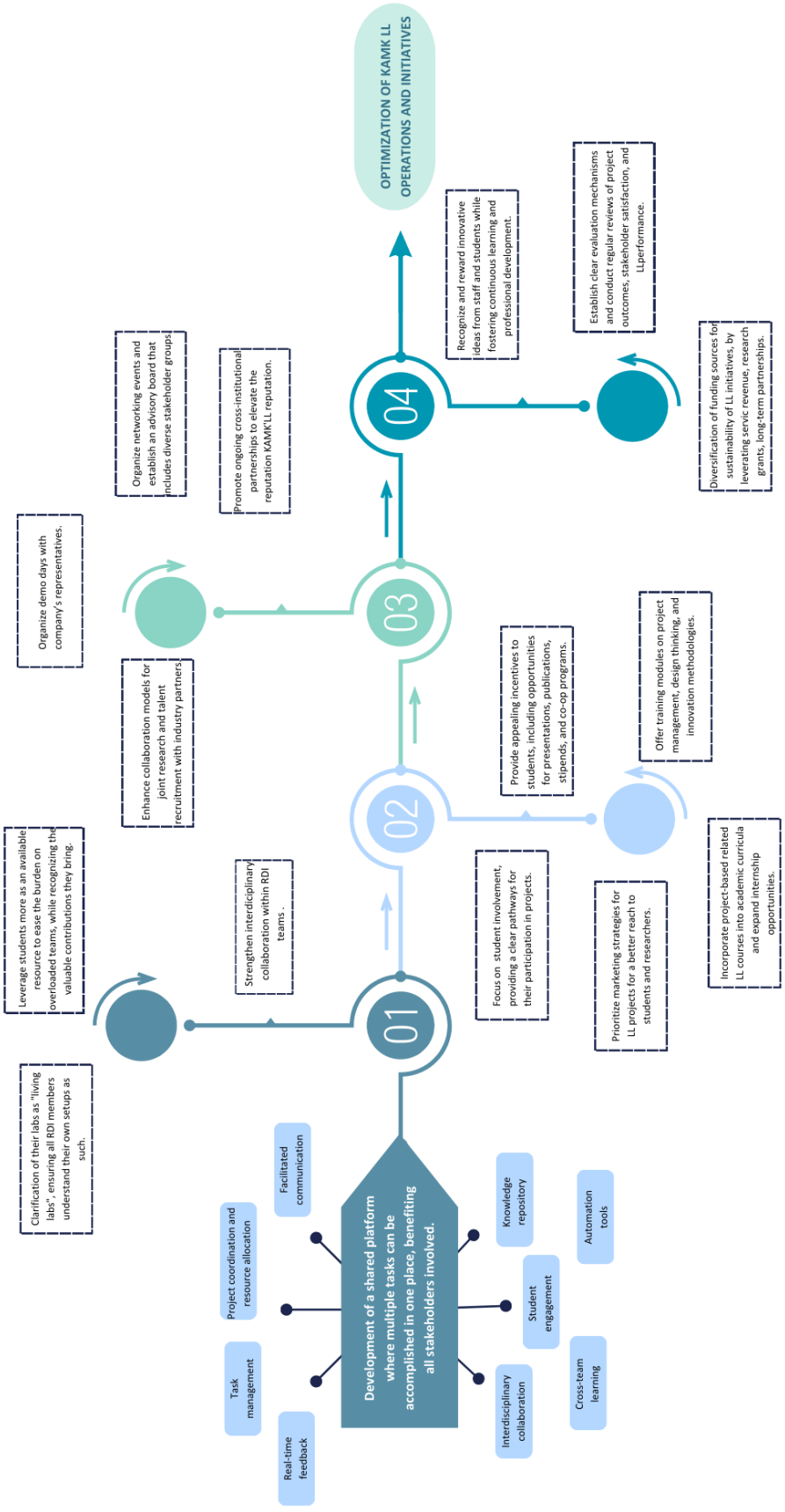

Figure 17 Proposed action roadmap for optimizing KAMK LL operations and initiatives.

Upon reviewing areas that need improvement, the researcher has identified opportunities to simplify teams' processes to enhance team collaboration and productivity. To address this, the development of a digital centralized platform is proposed to enhance project management, streamline coordination, and resource allocation, and improve communication for all parties, including students, faculty, researchers and external stakeholders. This unified hub aims to serve as repository for all project information, such as timelines, roles, responsibilities, task assignments and progress updates, being easily accessible and ensuring informed real-time updates and faster adaptability. This initiative fosters a cohesive environment, where all LL' involved actor can access and engage with project information effectively, promoting a smoother project flow and successful project outcomes.

Taking the form of a multi-device application, accessible across different devices, it serves as an all-in-one project management hub. Leveraging a cloud-based infrastructure ensures scalability and real-time accessibility for all participants, and API integration with existing university tools such as calendar apps and educational platforms, so that integration into existing workflows is smoother.

In addition to promoting open communication, the platform supports the efficient onboarding of new projects by matching them with the appropriate teams and resources, and by providing support and guidance for project scoping, goal setting, and milestone tracking. It allows clear structuring of governance, with defined roles and responsibilities for managing projects and resources, ensuring smooth coordination and efficiency across the labs.

Furthermore, it endorses interdisciplinary collaboration among teams by facilitating knowledge-sharing and networking opportunities, enabling teams from different disciplines to work together on projects and explore innovative solutions to complex challenges. As for students, it provides a space to discover and engage with ongoing projects that match their interests and skills and obtain mentorship and feedback from faculty and industry advisors, which supports their learning and professional growth. Furthermore, it fosters a culture of learning and continuous improvement through the repository of past projects, best practices, and lessons learned, to which access is granted to all teams.

Additionally, the platform integrates automation tools to boost efficiency and reduce manual workload, enhancing the experience for students, faculty, and stakeholders. It includes features that facilitate project matching and availability of students and faculty, scheduling, assigning tasks, and tracking progress across projects. It aids in organizing and categorizing project data,

maintains a repository of best practices, and eases teams' access to knowledge. It also supports onboarding with learning modules and tutorials for new students and team members. To evaluate performance, it generates reports on project progress and performance, identifying areas for improvement, while automated surveys and feedback collection tools gather input for future improvements. This directly impacts the labs' adaptability and responsiveness.

The researcher identified the potential of this approach to facilitate and strengthen interdisciplinary collaboration, provide hands-on learning experiences and professional development opportunities to students, which is in alignment with KAMK's educational goals, and streamline processes, boosting efficiency and productivity by reducing manual workload through automation tools. Consolidating multiple functions within a single shared platform can significantly enhance the overall effectiveness and efficiency of the RDI teams. This enables quicker implementation of updates and improvements, real-time access to data, facilitates quick responses to shifting market demands, and allows for clear governance structures and oversight across projects and teams, facilitating the establishment and maintenance of standardized processes across the labs. This approach can be viewed as a strategic move towards embracing digital LLs, enabling KAMK to adapt to the changing business environment by integrating all necessary functions into a single digital hub.

In addition to this approach, the researcher proposes the clarification of the labs as "living labs", ensuring all RDI members understand their own setups as such. As the institution is facing an increase on the volume of projects, RDI teams can utilize students as valuable resources to ease the burden of overloaded work. It is important to recognize the valuable contributions that students can bring.

Student participation is systematically integrated into the LLs through structured programs offering course credits, internships, and research opportunities. However, there needs to be clearer pathways for students to join projects at different stages, and targeted marketing strategies to ensure greater reach to students and researchers. To further engage students, project-based courses related to the LL initiatives can be incorporated into the academic curriculum, and internship opportunities can be expanded. Attractive incentives such as opportunities for presentations, publications, stipends, and co-op programs are provided to motivate students, Additionally, training modules on project management, design thinking, and innovation methodologies equip students with essential skills for success. By being involved in these projects, students gain experience and expertise which aid the team members to ease workload, while also contributing with

gained expertise. Professors are encouraged to participate as an actor in the LL initiatives as well as share their knowledge and expertise, by granting training modules.

Collaboration with companies is bolstered through enhanced joint research and talent recruitment models with industry partners, which benefits students One key aspect is organizing demo days, where company representatives visit the lab facilities to engage with the team and explore the prototypes being developed. This direct interaction fosters a feedback loop that is essential for refining projects. Additionally, hosting networking events brings together a diverse group of stakeholders, creating a platform for meaningful connections and enhancing the institution's reputation. An advisory board consisting of these stakeholders helps guide and shape project directions, ensuring they align with industry needs.

Moreover, it is imperative to emphasize the importance of evaluation mechanisms, which include establishing clear processes to regularly review project outcomes, stakeholder satisfaction, and the performance of the LLs. This can focus on tracking media reports to measure public perception and visibility of projects, peer reviews from other labs or similar initiatives providing fresh perspectives and constructive feedback, measuring long-term impact on participants and the community and other operation KPI’s. This structure supports the recognition and rewarding of innovative ideas from staff and students, thereby encouraging continuous learning and professional development. The emphasis on rewarding innovation nurtures a culture of creativity while sharing lessons from past projects helps teams apply insights to future initiatives for continuous improvement.

To tackle a common challenge, sustainable funding strategies focus on diversifying funding sources for the LLs’ initiatives, leveraging service revenue, and research grants, and establishing long-term partnerships. Additionally, seeking cross-institutional collaboration allows to access complementary expertise and resources, offering significant benefits. And engaging in global innovation networks, conferences, and exchange programs can strengthen these collaborations and open opportunities for growth and development. These recommended improvements aim to optimize the operations and initiative in KAMK LL.

7 Conclusions

This study aims to explore the ways in which KAMK can adapt to the changing educational landscape by bridging the gap between academic research and real-world innovation and empowering collaboration between companies and students. Its purpose is to foster harmony across siloed teams and enhance interdisciplinary collaboration for a growing number of projects at the studied HEI. The focus is on improving the functionality and operations of KAMK LLs to stimulate economic development and boost the institution’s competitive edge, thereby attracting skilled students, faculty, and research partners, and positioning the institution as a hub for innovation in higher education.

By interviewing KAMK RDI experts and benchmarking partnering HEIs, the study evaluates experiences, enablers, barriers, and best practices to improve KAMK's LL model, aiming to increase the effectiveness of KAMK's RDI initiatives by advancing open innovation, fostering knowledge sharing, and promoting collaboration within the university and with external partners.

Through a comprehensive analysis, the researcher identified key strategic areas for improvement, including collaborative research, student involvement, and knowledge sharing. Five major themes emerged, encompassing different aspects of KAMK LLs, such as collaboration ecosystem, stakeholder empowerment, contextual relevance, impactful innovation, and resilience and longevity of the ecosystem, which aligns with the principles of LL of openness, influence, realism, value, and sustainability.

It was observed the presence of multiple enablers and barriers. Effective communication and active collaboration with stakeholders are key to balancing involvement and optimizing outcomes, with project-based cooperation being highly valued. However, challenges affecting the effectiveness of the current LL model remain in knowledge sharing, a shortage of skilled individuals, and variability in methodologies across projects, affecting the cross-pollination of ideas, and collaboration, and limiting the transfer of best practices.

In addition, another finding is the imbalance in interdisciplinary representation within the teams, asking for the recruitment of students and researchers from diverse disciplines and fostering cross-field collaboration. Additionally, challenges arise in clarifying project vision and objectives to all members, emphasizing the need for inclusive and participatory decision-making to align activities among all parties. Accessibility of resources, including expertise, personnel allocation,

and student involvement, also poses challenges for the continuity and expansion of initiatives. While some teams foster innovation and creativity, others struggle with excessive workloads, limiting opportunities for creative thinking and team engagement. The variability of methodologies employed by different teams hinders the transfer of best practices between projects and limits the organization's ability to leverage past experiences effectively.

Sharing knowledge within teams can also be challenging, as insights and best practices may remain confined within specific departments. The value of having a clear value proposition is recognized, as it leads to impactful projects with tangible benefits for KAMK, stakeholders, and the community. Effective multi-level communication within teams and with partners is key to project success and overall progress. Moreover, a real-world context approach, feedback-driven strategies, and a focus on creating value for all parties are important, to ensure projects address tangible problems and solutions and real-world needs. In terms of ensuring the sustainability of the LL and fostering a robust ecosystem, it is imperative to address challenges regarding governance structures, funding limitations, and siloed institutional cultures. KAMK's RDI labs currently follow a provider-driven approach, acting as the primary resource for infrastructure and expertise. The institution's participation in a cross-border LL network opens opportunities for collaboration, innovation, and knowledge exchange with international partners. Yet, a lack of expertise, limited resources, knowledge sharing, and the workload challenges faced by staff are challenges present within the collaboration ecosystem.

Overall, the analysis highlighted the need to optimize the LL model by fostering interdisciplinary collaboration, enhancing stakeholder engagement, improving student involvement, and ensuring sustainable practices. Considering this, the researcher benchmarked partnering HEIs from the ENIHEI project, which provided different perspectives on managing and developing LL initiatives, highlighting similarities in fostering interdisciplinary collaboration, practical training for students, a focus on innovation and entrepreneurship, as well as showcased differences in funding models, organizational structures, and educational focus, offering a range of approaches for the researcher to consider for KAMK LL new model. By leveraging such experiences, lessons learned and best practices, the researcher co-created with the commissioner representative of the project to develop a new model for KAMK LL to enhance the effectiveness, impact, and sustainability of their LL initiatives.

With a focus on the key areas of improvement and based on the challenges and barriers highlighted, the researcher concluded that KAMK can enhance its LL initiative by focusing on interdisciplinary collaboration, student involvement, and building a strong network of stakeholders to

support projects and improving internal knowledge sharing to strengthen their effectiveness and sustainability within the living lab framework. Implementing more systematic approaches and clear guidelines for projects can help in overcoming the identified barriers. By leveraging feedback mechanisms and evaluation processes, KAMK can continuously refine its practices and enhance its impact, as the iterative nature of the living lab approach emphasizes the importance of continuous learning, reflection, and improvement. By improving the current LL model, KAMK can enhance collaborative research, open innovation, student involvement, and knowledge sharing both within its ecosystem and with external partners.

The operations within KAMK LLs encompass a holistic approach centred around academic education, regional development, and research and development. These interconnected areas bring together diverse stakeholders, driving innovation offering practical learning experiences for students, conducting impactful research, and supporting regional economic development, forming a holistic ecosystem that bridges the gap between research and commercialization. To bridge the gap between research and commercialization and address the European paradox, KAMK's LLs focus on advancing knowledge and innovation in the region while aiding industry partners in developing, testing, and commercializing products more efficiently. For students, LLs provide hands-on learning experiences and skill development in real-world settings, while faculty and researchers benefit from practical research opportunities and collaborations with industry and government.

The researcher's strategic recommendations are aimed at addressing these challenges and further optimizing the LL operations by enhancing interdisciplinary collaboration, student involvement, and partnerships with industry and other institutions.

8 Discussion

Innovation is a driving force for progress globally in society, economy, technology, and sustainability, making it a priority for governments, businesses, universities, and civil society. LL exemplifies this commitment by nurturing creativity, problem-solving, and the exchange of ideas and resources across diverse disciplines and sectors. This approach promotes collaboration among multiple stakeholders and active participation in solving complex challenges. By leveraging tacit knowledge and real-life validations, LL strategies aim to improve the design process for new products and services, streamline development timelines, and ensure successful market integration (Veeckman et al., 2013, p. 4).

This study explored the state-of-the-art development of LL in HEIs, where universities like KAMK play a dual role as both funders and organizers. As funders, universities provide key resources, such as financial support, to establish and sustain LLs, and as organizers, they manage the infrastructure and operations, facilitating interdisciplinary collaboration by bringing together faculty, researchers, students and external partners to work on LL projects. As KAMK deepened its commitment to this innovative approach, the researcher examined the development of the institution's RDI operations and initiatives to enhance these efforts and highlight the LL's impact on innovation processes. The aim is to strengthen the institution's role in advancing innovation by increasing collaboration and stakeholder involvement, including students.

To achieve this, the researcher examined how KAMK's current RDI labs align with overall established LL principles **(Q1)**. The findings revealed that the current operations demonstrate a significant alignment with key LL principles, particularly openness, influence, realism, value, and sustainability (Bergvall-Kåreborn et al., 2009).

The RDI teams strongly emphasize collaboration among diverse stakeholders, including students, which accelerates development and nurtures innovation (Bergvall-Kåreborn et al., 2009). This emphasis on engagement contributes to the success of projects, but there is potential to further involve students and improve knowledge exchange, both within the organization and with external parties, as well as improve interdisciplinary collaboration while addressing team silos. Moreover, the importance of stakeholders' and users' needs and involvement in the co-creation and decision-making process is strongly emphasized, which results in strong engagement and iterative collaboration with partners, imperative for iterative design. This focus ensures projects are

responsive to the needs and perspectives of various stakeholders, contributing to more tailored and impactful outcomes (Bergvall-Kåreborn et al., 2009; Mulder & Kriens, 2008, p. 3).

This is more emphasized, as the RDI project-based initiatives are grounded in real-world contexts, prioritizing early feedback and tackling industry and community challenges, through a cyclical and iterative process. This pragmatic approach aligns with the principle of realism, yielding valid results applicable to real markets and actual needs (Bergvall-Kåreborn et al., 2009). The researcher's analysis indicates that the roles and composition of stakeholders vary depending on the project scope, which reflects on the adaptation and flexibility to engage in phases of exploration, experimentation, and evaluation (van den Heuvel et al., 2021, p. 35).

Additionally, the RDI teams undertake diverse projects that are relevant and impactful for the institution, community, and region benefit, focusing on delivering tangible value, such as economic, societal, or technological, to diverse stakeholders. This effort supports the principle of value by creating meaningful outcomes for all parties involved and ensuring the proper translation of innovation into practical utility (Bergvall-Kåreborn et al., 2009). In order to sustain the LL initiatives, a strong ecosystem is fundamental, yet challenges such as governance structures, funding limitations, and a culture of innovation present barriers to the longevity of the labs. Addressing these issues aligns with the principle of sustainability and ensures the long-term viability of the labs. Positively, there is a focus on research translation, continuous learning, and partnerships, which supports the labs' long-term viability and feasibility (Bergvall-Kåreborn et al., 2009).

Considering this, KAMK's RDI labs align with overall LL principles, making them dynamic and inclusive spaces for innovation, being key parts of broader innovation systems and cross-border LL networks. These principles guide innovation development by helping achieve specific goals and strategies, each principle addressing a unique aspect of LL structure and processes and collectively forming a core philosophy and framework that distinguishes LLs from other innovation methods (Bergvall-Kåreborn et al., 2009).

Furthermore, an LL's success heavily depends on the quality of its governance, which can either foster its growth and effectiveness or hinder its progress. Effective governance can drive an LL towards achieving its goals, while poor governance can lead to inefficiency and potential failure. Considering this, KAMK RDI labs' governance is influenced by both enablers and challenges. Key enablers such as iterative processes, collaboration, and partnerships facilitate informed decision-making and project continuation. However, challenges like resource accessibility, funding allocation, and personnel distribution impact continuity and growth. Communication and knowledge

sharing within teams can be difficult, especially across departments. Following a provider-driven approach, the labs leverage institutional resources and partnerships with stakeholders. From a general point of view, the analysis shows that the methods involved in the LL are not affected by whether the labs are in real or virtual settings.

Moreover, the governance approach at the HEI is in alignment with Nyström et al., pp. (2014, pp. 487–489) role patterns, which balance exploratory and practical activities (ambidexterity), promote mutual exchange among stakeholders (reciprocity), refine solutions based on real-world feedback (temporality), and benefit from diverse perspectives and expertise (multiplicity). This builds a collaborative environment that connects academic research with practical applications, thereby enhancing the impact of the KAMK RDI labs.

8.1 Recommendations

Through the comprehensive analysis of the HEI labs and benchmarking with three other HEIs, the researcher focuses on the key points KAMK, and its ecosystem need to prioritize to strategically develop and enhance its LLs **(Q2)**, advance innovation, and attract stakeholders by leveraging its knowledge in the current competitive economy. This can be achieved through collaboration in innovation networks involving universities, companies, and governments throughout the process (Etzkowitz & Klofsten, 2005, p. 243). This is in line with Eschenbächer et al., p. (2010, p. 24) key points which include trust, clear rules, and active key persons, all key for successful LLs.

Operating by an LL approach amplifies key benefits for KAMK, such as gaining context-specific insights into development and adoption, enabling experimentation that reveals conditions for technology integration, and visualizing potential societal effects by immersing technology in real-life contexts (Ballon & Schuurman, 2015). This is beneficial for the HEI, its stakeholders, the community, and the region, especially in peripheral regions.

The analysis highlighted the need to prioritize strategies that enhance interdisciplinary collaboration among researchers, students, and industry experts; student involvement; orientation for the increasing project volume; communication; stakeholder engagement to further boost the network of partnerships; and knowledge sharing, as insights often remain confined within specific departments. These challenges are quite common across university LLs (Hadfield et al., 2023, p. 6).

In light of these findings, and in order to optimize the development of KAMK's LL and strengthen collaboration, enhance innovation, and contribute to the economic development of the Kainuu region **(Q3)**, a set of targeted recommendations is proposed, as illustrated on figure 6.

Firstly, the researcher noted the need for the HEI to clarify the role of its RDI labs as LL to all members within the institution, fostering a shared identity and purpose within the organization. While recognized as LLs, a lack of awareness among lab members is limiting their ability to fully apply the LL approach. The established criteria and approach for LL are not always followed by projects labelled as such, which potentially leads to confusion and challenges in evaluating their effectiveness (Berberi et al., 2023, p. 16). Thus, such clarification has the potential to lead to more cohesive teamwork, enhance knowledge sharing, improve project outcomes, and better alignment with LL principles.

In addition, the researcher recommends the development of a centralized collaboration platform for project management and communication to improve coordination, resource allocation, communication and real-time feedback among all stakeholders. This approach supports interdisciplinary collaboration among teams, allowing students, faculty, and external stakeholders to easily access and share project information and real-time updates, boosting overall efficiency and productivity, facilitating open communication and streamlining processes, promoting networking opportunities, and enabling teams from different disciplines to work together on innovative projects. Such a platform aligns with digital LLs' focus on leveraging digital technologies for innovation and collaboration and supports the shift to a knowledge economy that relies on technology and information for growth (Baran & Berkowicz, 2021). This approach also aims to aid in the harmonization of the LL methods and tools utilized, within and out of the lab, which is key for regional growth and development (Mulder & Kriens, 2008, p. 5). The platform can facilitate the dissemination of co-creative and collaborative activities through web portals, social networks, and newsletters. These digital tools can stream short video content showcasing services, prototypes, and research outcomes to a broader audience, including those not directly involved in the innovation process.

Strengthening stakeholder engagement through collaboration with businesses, community organizations, and government bodies will amplify partnerships and create opportunities for research and development. This approach deepens the understanding of user challenges and aids in developing impactful solutions that can revolutionize industries. As KAMK engages in a public-private-people partnership (4Ps), this process improves market evaluation, accelerates innovation development, and provides cost-effective access to industry partners diverse networks and

funding sources for research and implementation (Compagnucci et al., 2021, p. 5) and scale their innovations in real-life contexts (Veeckman et al., 2013, p. 4).

Third, encouraging interdisciplinary collaboration among researchers, students, and industry experts to lead to innovative solutions, enhanced knowledge sharing, and iterative development with holistic design. Learning from peers and sharing knowledge creates an environment conducive to the success of LL initiatives (Hummels & Vinke, 2010, p. 2), hence is imperative to foster a lifelong learning within the teams. Since the LL plays a strategic role in enhancing knowledge transfer (Compagnucci et al., 2021, p. 13), it is key to involve students more actively and enable them to apply their knowledge, skills, and abilities by engaging with stakeholders and experts, and strategically leveraging students as valuable resources to ease the burden of increased project volume. Participation in such initiatives positively impacts student's professional and personal development, by enhancing their knowledge and competencies skill set (Falk-Kessler et al., 2007, p. 91). Professors are also encouraged to participate and share their knowledge by teaching design thinking, project management, and innovation methodologies.

Additionally, fostering collaboration with external stakeholders is crucial for creating valuable connections and feedback loops for refining projects. Hence, joint research, talent recruitment models, hosting networking events, and demo days is recommended to facilitate meaningful interactions and guide project directions. Engaging in global innovation networks, conferences, and exchange programs can strengthen collaborations and open growth opportunities, which can bring new perspectives and expertise to the labs, amplifying their impact and reach. Nyborg et al., p. (2023, p. 15) asserted that LL is an easy way for industries to collaborate with universities via small-scale projects, where companies have access to students, and LL provides students access to real-life problems to solve.

Establishing clear evaluation mechanisms is equally essential for regularly assessing project outcomes and stakeholder satisfaction. Evaluating LL by triangulating between environment, approach, and outcome is useful for assessing LL maturity and identifying areas for improvement (Veeckman et al., 2013, p. 6). Lastly, implementing sustainable funding strategies through diversified sources such as leveraging service revenue, and establishing long-term partnerships will support the long-term viability and growth of the labs.

The researcher suggests that increasing the presence of LL at KAMK may involve modifying daily practices, redefining roles and relationships between team members and students, and fostering a cultural shift within the RDI teams. The proposed recommendations can transform the HEI from

within, creating new identities and narratives that have the potential to position it as a leading institution in LL practices. By focusing on these key points and strategies, the commissioner institution can optimize its LL operations and initiatives, enhance innovation, and support sustainable regional development in the Kainuu region. Ultimately, implementing these changes will provide guidance to KAMK's further success in the LL field and set an example for other HEIs.

8.2 Suggestions for Further Research

The researcher recommends further investigation into enhancing LL operations within HEIs. Explore the impacts of integrating interdisciplinary education in LLs, including investigating how digital tools improve collaborative processes and sustain the co-creation process within LLs, as well as further studying the benefits of digital LLs.

Regarding AI integration, future researchers could assess both the opportunities and threats for responsible research and innovation, including ethical concerns such as data privacy and algorithmic bias.

Studying the long-term effects of LL collaborations on student learning, career trajectories, and professional growth can also be a valuable strategy for understanding the effectiveness of such approaches. Exploring the scalability of successful LL models within HEIs can help determine how they can be adapted and replicated in various institutional, cultural, and regional settings. Additionally, there are principles for assessing LL organization and methodology, however, impact criteria remain broad and difficult for labs to evaluate independently. Hence, further research into methods to efficiently assess the labs is needed.

These further studies are aimed at enhancing LL operations and improving learning outcomes for students, ultimately strengthening the bridge between academia and industry.

8.3 Reliability and Trustworthiness

This research was conducted following the principles of responsible conduct of research of the Finnish National Board on Research Integrity TENK (2021). Various measures were adopted to ensure compliance with these guidelines throughout the study. The research plan received approval from the ethics committee to guarantee compliance with ethical standards and participant

protection. Informed consent was obtained from all participants, who were provided with clear information about the research's purpose, aim and methods. In addition, the participant confidentiality and privacy were preserved through data anonymization and secure storage. The researcher followed ethical guidelines for data management, avoided plagiarism, and proper source acknowledgment to maintain academic integrity.

The reliability of data and findings is a essential requirement in any research process. Reliability refers to the consistency, dependability, and replicability of the results obtained from research. Thus, it implies how consistently a method measures produces the same results when applied repeatedly under the same conditions. It is crucial in ensuring the validity and credibility of research findings, by guarding against errors and affirming genuine differences or relationships in the data (Saunders et al., 2016, p. 202).

Methodological rigor lies at the core of ensuring the reliability of the research conducted. The researcher employed multi-method qualitative methods, adhering to rigorous standards of data collection, analysis, and interpretation. The research design was selected, and the study was conducted by conforming to scientific standards. The research results were openly and responsibly communicated, and all sources of previous research and other information were cited appropriately.The researcher ensures the dependability of the results by explaining the research's processes and phases, collecting diverse information from various sources to enhance data reliability, and providing detailed descriptions of data collection, analysis, theme derivation, and result attainment. These measures collectively contribute to the reliability of the research outcomes.

The researcher employed the technique of triangulation. Triangulation of data collection techniques strengthened the validity of the results to some extent (Saunders et al., 2016, p. 207). Interviews were conducted to KAMK LL' members and benchmarking partner HEIs to provide a broader and deeper view of the development and management of LL initiatives. In addition to the researcher, the commissioner' project responsible assisted in the development of the new model for KAMK. By seeking input from various perspectives, the researcher ensured that the research conducted was relevant, inclusive, and responsive to real-world needs.

In terms of trustworthiness, it involves the transparency, integrity, and ethical conduct of the research process. Transparency was maintained throughout the research process, from project inception to dissemination of results. Upholding ethical standards of research conduct, including informed consent, confidentiality, and respect for participant autonomy, was a priority.

As a case study, the results of the thesis hold promise for broader applicability beyond their immediate context. If found relevant and beneficial, the insights derived from this research have the capacity to be extended and implemented in other HEI. Moreover, the benefit of the research for the commissioner is noteworthy.

8.4 Learning Outcomes

The thesis showed to be a great opportunity for the researcher to develop key competencies in the research, ethics, critical thinking, innovation, problem-solving, and internationalization, aligning with the master's degree competencies of KAMK. The thesis showed to be a great opportunity for the researcher to develop key competencies in the research, ethics, critical thinking, innovation, problem-solving, and internationalization, aligning with the master's degree competencies of KAMK. And thus, through this journey, the researcher met professional and academic expectations at the master's level within the university of applied sciences context (Auvinen et al., 2022), including continuous learning and competence development, effective work management, ethical and sustainable practices, working in international environments, and supporting future-oriented innovation.

Exploring and selecting the most relevant information from former research and reporting the results of the research were the most challenging parts of the process, in the view of the researcher. Nonetheless, it was very useful in structuring thoughts into a logical form in the light of the theoretical context, as the process of synthesizing diverse viewpoints from the data enhanced the researcher’ under-standing of the complexities within the LLs development topic.

The most rewarding part was collecting and analysing the data, particularly interviewing KAMK'LL members with different roles and experiences, which brought interesting perspectives to the meaning of the research. Also, cooperation with the partnering HEIs was a great way to connect and cross-collaborate with other universities, being able to participate in a multicultural environment and enriching the researcher’s professional connections.

The thesis journey fostered resilience and adaptability, not only enhancing the researcher's academic skills but also contributing to personal and professional growth. The skills and knowledge acquired through this endeavour will serve as a strong foundation for future academic and career pursuits.

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Thesis material management plan

1. General description of the material

In academic research, the choice of research material is crucial for shaping the quality and depth of a thesis based on its research objectives and methodology. This thesis research material was primarily derived from interviews with KAMK's RDI coordinators, and experienced experts in research and innovation, with a semi-structured format to obtain in-depth data on various aspects of RDI processes within KAMK.

Additionally, collaborative workshops were conducted with partner universities, designed to explore innovative LLs practices and promote cross-institutional collaboration, through collaborative activities as a source of qualitative data. This combination offered a comprehensive perspective on the research subject.

Furthermore, the thesis drew upon academic articles and journals related to LLs, enhancing the depth and credibility by aligning primary data with secondary data.

2. Documentation and quality of the material

To ensure the research's reliability, meticulous documentation, and quality assurance are key elements, which incorporated interviews, collaborative workshops, and academic articles as research materials, several key practices were implemented.

Throughout the data collection, each data piece was recorded, including participant details for interviews and workshop specifics. Transcriptions and audio recordings ensured data accuracy for interviews. To organize, a systematic coding and categorization process helped to analyze the data, and specialized software, ATLAS, facilitated efficient data management.

Validation measures, such as cross-validation were applied to enhance data quality, as well as data security measures to prevent data loss or breach. Ethical considerations were followed, including informed consent and proper citation for academic sources.

3. Storage and backup

In the thesis research process, stringent measures were taken to safeguard the integrity and security of the various research materials, encompassing interviews, workshop notes, and academic articles. Digital data was stored with protective layers, including password protection, or on drives only accessed by the researcher. Physical materials, such as printed documents, were similarly stored securely, typically in restricted-access facilities.

4. Ethical and legal issues related to storage

Ethical considerations are utmost in data handling, with adherence to guidelines that protect participant confidentiality and privacy. Informed consent from participants in interviews was obtained and identities were anonymized. Access to the research materials was controlled and limited to authorized personnel (research team and supervisor). Particular attention was given to addressing ethical concerns in material storage, particularly when dealing with sensitive information, where data is securely stored. Intellectual property rights and ethical guidelines were followed when citing or using research materials from external sources, such as academic articles and journals.

5. Opening the material and long-term storage

Ensuring the future use of research material is a key aspect of responsible data management as researchers aim to preserve collected data and insights for future studies, comparisons, or ongoing research endeavors. To achieve this, meticulous practices such as proper documentation, detail notes, and research materials, whether digital or physical, were organized systematically, to ensure that materials remain accessible and useful over time.

Appendix 1 – Interview Guide

Questions regarding KAMK RDI labs practices:

Research project overview and management:

1. Overview of the current research project, objectives, and focus areas.

2. Which criteria RDI teams use to prioritize and select research projects?

3. Could you share any information regarding the frameworks or methodologies that RDI teams employ to carry out its RDI work?

Stakeholder engagement and collaboration:

4. How do RDI projects typically involve end-users or stakeholders in their development process, and what specific strategies or methods are commonly used for engagement?

5. How often do collaboration with actors within RDI projects happens, and if so, what type of actors?

6. Could you provide insights into whether RDI projects embrace an interactive and feedback-driven approach, and if so, what type of mechanisms are used to adjust and improve solutions based on user input?

7. What role does collaboration with external partners (universities, industry, or government entities) play in the RDI team's activities?

Student involvement and innovation culture:

8. How do students typically participate in projects, and can you provide some insights into their level of involvement?

9. How does RDI teams foster a culture of innovation and creativity among its researchers?

10. How does RDI teams encourage knowledge sharing and the dissemination of research findings, and to what extent is this a common practice between researchers?

Project context and impact:

11. Could you explain on how real-world contexts are integrated into the RDI projects, and perhaps share an example.

12. Can you describe whether the RDI activities settings are primarily physical (physical spaces and equipment) or more virtual (online or digital environments)?

13. How do RDI teams consider industry needs, respond to emerging challenges, and seize new opportunities in the market?

14. How does RDI teams ensure the transfer of research outcomes into practical applications or products?

15. How ethical considerations and data privacy are handled?

Living Lab approach and perspective:

16. In your opinion, how does the concept of Living lab differ from traditional academic research and innovation practice? Do you see any advantage or disadvantage for adopting a LL approach?

17. Can you sketch your perspective of KAMK' RDI teams, highlighting key components, functions, stakeholders, etc. Do you think any aspect or element is currently left out or understated?

Appendix 2 – Agenda of the workshop

Collaborative Workshop: Sharing Best Practices for Living Labs Development

Workshop Objectives:

- Share experiences and best practices in the development and management of living labs among participating universities.
- Identify common challenges and success factors associated with living labs.
- Facilitate active engagement of all participants.
- Support knowledge exchange, including between participants.
- Generate recommendations for enhancing the development of living labs based on shared insights.
- Provide real value for participants and equip them with solutions that they can apply in their living labs.

AGENDA

Introduction **(18:00 – 18:10)**	Greetings and introduction of participating HEIs and their representatives. Each university representative presents an overview of their LL initiative **(15 minutes)**, including: **1. Objectives and goals of the living lab.** **2. Target stakeholders and areas of focus.** **3. Key activities and projects undertaken.** **4. Overall model of their living lab - External and internal focus, emphasizing the internal.** **5. Challenges and how they are overcome (success factors and bottlenecks);**
Living Lab – **Ca' Foscari University of Venice (18:10 – 18:25)**	
Living Lab - **Technical University of Gabrovo (18:25 – 18:40)**	
Break **(18:40 – 18:45)**	
Collaborative activity **(18:45 – 19:15)**	
Discussion of Results **(19:15 – 19:25)**	
Closing Remarks **(19:25 – 19:30)**	

Appendix 3 – Thematic content analysis sample interview excerpts.

Key principle	Themes	Codes				
Openness	**Collaboration Ecosystem**	*Communication*	"For sure interactive.(...) it's not just us doing something and asking for feedback; they also provide examples of what they've been doing in certain areas, and then we elaborate together on how to improve in the future."	"If you have stakeholders or customers, we try to make the communication kind of very direct, well, in a way that both parties are speaking"	"I assume that communication and collaboration with stakeholders—whether regional players, educational institutes, companies from various sectors, or industrial partners—is essential."	"This involves weekly communication between our teachers and company executives, among others"
		Stakeholder engagement/diversity	"Level of involvement depends on the actors involved and heavily depends on what type of project, and state of the project."	"As we move towards the use case or development phase, where the company can benefit or provide facilities for prototyping and testing, their involvement becomes heavier, possibly lasting up to half a year."	"Regarding being business-driven, it means that our stakeholders, industry partners, and research institutions are crucial collaborators"	"You don't want to overload the stakeholders and the companies with tonnes of work addition to what they have, but they are involved in the development process"
		Participation levels of students	"The level of involvement really could be better, like that's a problem for us. So the way students typically participate, it's sometimes through project work internships in the lab. But the problem is, to be very honest, we lack students here at KAMK who are interested in internships or working in the lab. "I think is a bit unclear for the students."	"In terms of involvement in whole or part of a project, it depends on the type of project. Sometimes students may only play a minor role, like being one of two makers, while other times they might take on a larger role, such as handling small tasks like sound or dialogue in a larger project. Additionally, when it comes to thesis projects, we often introduce new technologies, and students learn how to use them, create reports, and pass on their knowledge to our staff. This allows our team to adopt new technologies more quickly than if they had to learn them on their own."	"So, the level of engagement depends on the project" "Although our current collaboration with students is limited, my hope is that in the future, we can involve them more actively."	"This is one issue. The problem with our product is that very few process area students are involved in the projects. One reason for our master's program is that most of our students are focused on their coursework, and our processes are not closely integrated with their work."
		Transparency measures/ knowledge sharing	"However, some may feel threatened by sharing, fearing it may jeopardize their position. Sharing knowledge is essential for personal and collective growth. It's evident that individual professional development is limited without collaboration. We must surround ourselves with experts to thrive"	"We try to maintain transparency in everything we create. But, it can be challenging due to the diversity of fields we operate in, leading to knowledge transfer issues within the team" "We're open to sharing knowledge with researchers or other interested parties, while ensuring that any confidential information remains undisclosed"	"There are not enough resources to participate enough (...) our teams are scattered, not working together, and it's rather hard to get the information from different teams. There might even be barriers between the teams, even though we are residing within the same confidence area, so that's unfortunate."	"The challenge lies in effectively transferring the knowledge gained during development, especially when it's not easily conveyed through text or documentation. This is particularly true for coding, where comments are crucial for understanding. Without proper documentation, examples become useless."
		Expertise	"The main bottleneck is the shortage of skilled individuals. So, sharing knowledge strengthens our collective capabilities and benefits everyone involved."	"We usually lack expertise in the areas we work on, so our strength lies in having this kind of method that gathers information and data from customers and translates it into the game."	"Experts themselves, and finding the right persons can be hard"	"There are really not enough viable resources and expertise to guide new funding, to provide those funds and applications, and we are suffering from that also.
Influence	**Stakeholder empowerment**	*Recognizing and collaborating with relevant stakeholders / Perceived need by stakeholders*	"It's usually public entities like municipalities that recognize the need for action, yet they often lack the resources and expertise to implement solutions effectively (...)This highlights the importance of collaboration	"However, most project ideas come from stakeholders or a combination thereof, indicating a perceived need or opportunity for improvement."	"It's a common starting point for us to go to a company and ask, 'So what do you need? What are the problem areas you need development in?' Then we try to find some sort of	"The feedback or ideas gathered from them are also the correct starting point for the project. Alternatively, we can of course do it vice versa so that we can follow

			between industrial players and public stakeholders. Ultimately, it comes down to recognizing and collaborating with the most relevant stakeholders actively"		simulation or game solution for that."	the market, make assessments of the new market potential, etc., and then share the ideas that the company collaborates as part. In my opinion is harder that way (....)"
		Co-creation /Iterative collaboration with partners / Collaborative problem-solving	"We need to consider how to engage them, especially if the ideas emerge from ongoing collaboration where they identify bottlenecks or needs."	"We then elaborate on those ideas together before they're formally proposed (...) the collaborative nature of developing the project idea with stakeholders before it's finalized and presented? This ensures their direct engagement as they call that in terms of going to the topics, writing and developing, shaping, and refining the project's objectives and content."	"We also ask for their opinions, what they think needs to be explored more, what explanations are missing, and their proposals for the next steps. We keep them involved as we have co-planning of activities with them, because of the nature of this kind of project"	"we're actively consulting with companies to understand their specific educational needs, starting from the planning process all the way through implementation"
		Stakeholder engagement	"Particularly focusing on engaging with professional stakeholders rather than solely academia."	"We strive to involve customers and stakeholders as much as possible, even if their feedback is positive"	""But in my opinion, again, I must highlight that the end user or stakeholder involvement should be much more frequent and systematic. - However, this can be challenging as stakeholders are often busy, and articulating the project's added value may not always be straightforward"	"It depends on the type of project we have, but they are involved throughout the entire project. We discuss and work on it during the planning and execution phases—essentially, throughout the entire lifecycle of the project. However, their level of involvement varies depending on the project's content"
		Actors	"Regarding R&D projects, I believe the most effective approach is to involve companies, end-users, or stakeholders directly in the project."	"We have also had governmental players involved, with priorities set, and other educational institutions such as universities and applied sciences joining the project alongside companies and academia"	"Regarding external partners, we have universal academia, industry partners, government entities, and collaboration with these external partners"	"Primarily, we collaborate with stakeholders, end users, companies, and partners to plan project details."
Realism	**Contextual Relevance**	*Early refinement based on customer's feedback*	"Furthermore, we try to test everything we do as early as possible with end users or, at the very least, with the customer. So, involving the customer in all phases of development is standard practice for us."	"It's making us more flexible, a bit more agile in a way that you know, with the feedback, we can move faster in a way and we are closer to companies and such kinds of operations"	"Usually, we discuss our project ideas with industries to see if they are interested before finalizing concepts"	"Our proactive approach helps companies stay ahead of such challenges and ensures their long-term success.
		Real-world context	"When developing solutions for a company, we always focus on real-world examples and reward settings in the development process"	"My projects, real-world context is always present in the development. all the project ideas were originated from some real work"	"we try to integrate real-world contexts into our activities, leveraging feedback from stakeholders." / "the goal is to implement developments in real-life settings so that implementation is a success"	"All of our products are integrated into real life. (...) We always receive needs from companies or businesses, like working with them directly to understand their requirements. It's very clear that our work is closely tied to real-world activities."
		Industry relevance	"Conducting research at the beginning before applying for funding and during the whole project, ensuring that we address industry needs and adapt to emerging challenges is typically well-addressed.	"Our role is making them aware of upcoming changes, especially in times of rapid change like the present. That's very important, especially in the times we're living at	"We don't just come up with an idea and jump into a project; rather, we base our projects on a thorough understanding of what's happening in the world. This approach ensures	""it requires tailored solutions for specific industry needs. Hence, our approach is highly specialized"

			Exploring new market opportunities is particularly important."	the moment that it's changes happening all over the place."	that we avoid the problem of implementing projects that don't align with real-world needs, which has been an issue in some cases. We strive to stay ahead as a business intelligence unit, learning from markets and technology trends."	"We aim to encourage them to think about the future - what it holds, what potential opportunities might arise. We don't just address current needs; we also strive to anticipate future ones and explore emerging possibilities"
Value	**Impactful Innovation**	*Perceived value proposition for all participants and stakeholders*	"We ensure that everything we produce is highly practical in nature."	"We must prioritize our strategy; it's pointless to embark on a research project solely for financial gain. We need to derive benefits for ourselves, our education, and our strategic goals. Additionally, we should ensure that the local community benefits, as we primarily operate at a regional level, with some national and international reach. However, we must prioritize the local community's interests and ensure they receive tangible benefit"	"Our university's role is to develop our region, focusing on improving the local economy through partnerships with regional companies and research organizations. While we are open to collaborating with partners outside our region, our primary focus is always on how such collaborations benefit our local development."	
		Dissemination of results / Ethical considerations	"We try to make everything we create available in some form. When we learn something new, we typically produce a report, wiki, or document summarizing our findings. Our games are usually accessible in some way. If someone asks how we accomplished something and it's not integral to our source code, we're usually able to explain the process and guide them through it."	"that's part of every project. So we always have to design how to disseminate information to stakeholders, how to communicate it, and so on. We've done everything from seminars to booklets, reports, and online digital reports, and distributed them at different events. It depends on the case and the target group."	"It's highly encouraged, especially if we're undertaking projects without national or regional funding, as those are often our main funding sources. The free and open sharing of information is a necessary part of the project"	"The dissemination is more limited, but now we have at least opened up a little bit. (...) We want to ensure that everything we do is beneficial and practical. We're not solely engaged in academic research; we must always consider how to apply and commercialize our findings. // "hey are regulations that must be followed when we receive funding from public organizations. It's important to adhere to these rules."
		Feedback-driven (Testing solution and refining based on feedback)	"If we want everything to work well together, everyone needs to play their part. So, it's like real-time feedback between different project actors to ensure that the big picture is clear."	"We also ask for their opinions, what they think needs to be explored more, what explanations are missing, and their proposals for the next steps. We keep them involved as we have co-planning of activities with them, because of the nature of this kind of project"	"We developed the program, created courses and content, and constantly sought feedback from them. Companies were also involved in defining the content, which covered various aspects including programming, machine learning, data analytics, and some business aspects."	"Primarily, we collaborate with stakeholders (...) We consistently engage with companies and gather feedback to understand what needs improvement in our project activities. It's gratifying to collect feedback on a daily basis and discuss it with companies. Whenever there's an opportunity for engagement, we always seek feedback to refine our solutions in collaborative environments."
Sustainability	**Resilient / Longevity Ecosystem**	*Funding*	"Our approach typically requires funding, so the topic must be sufficiently interesting to attract investment. Let's assume we'll need some financial support for it. This is usually the primary motivation (...) all these project	"I will still say that the available funding is still kind of a large factor in our decisions."	"We need to prioritize our direction based on available funding, as our projects are entirely project-based. This means we must align our focus with programs or development processes that have funding"	"We often operate using public funds" "Fortunately, nowadays there are funding programs that support our projects, with the expectation that

			ideas originate either from stakeholders or through collaboration among stakeholders."	"Funding considerations can sometimes be challenging as we need substantial resources."		we actively engage in dissemination. We've observed that most funders acknowledge and support this perspective"
		Settings	"So, while we do utilize online and digital tools, the importance of physical settings cannot be overstated (...) I prefer a more physical approach, especially since we often engage in real-life piloting" "The innovation environment online, it's not really conducive to that. The level of innovativeness is really low. When you're just online, you tend to focus on a certain agenda or task"	"Currently, our approach is a blend of both physical and digital elements, and physical settings may sometimes facilitate more efficient project development (...) we actually rely quite heavily on physical equipment and spaces, especially for virtual reality applications. (...) So, when they are in the same space, the communication is more fluid."	"I think when it comes to innovation, physical settings are more important. Projects run better in physical settings. (...) And the more innovative you want to be, the more physical interaction you need. This has been my experience at many management levels. Physically interacting with clients and employees in companies is very important. It fosters informal communication, like chatting over coffee, sharing problems, and brainstorming solutions. These kinds of interactions don't happen as often online. With my team, we often start discussing cases and brainstorming ideas."	"Physical environments are good places for innovation and testing something (...) we should have those; we can't do everything virtually"
		Build innovation/innovation culture	"Many individuals get motivation from staying up-to-date with what's happening in the outside world. It's common for some to already possess a natural inclination towards innovation, that really don't need to be encouraged, and engage with various stakeholders for new ideas. It's important to trust that this inclination exists without needing much encouragement."	"I would say that the whole team is built in a way where we give a lot of freedom to people to create their own solutions.(...) we might just say, 'This is the end goal, we need to create this, and figure it out." //"But, we've deliberately built a team that can be innovative and create these games." We've been kind of deliberately building a team that can be innovative and create these games" "About culture of innovation, it depends on the project manager."	"We have activities, of course, you know what we need to do, but let's say within the framework of these activities, there is no limit except this framework. (...) We have the framework, and at the end of the day, we have the mandate to deliver.(...) So we have to keep oriented innovation in a way so (....) you have your choices, limitations, and time constraints. For some kinds of things, we need to say no. I mean, we don't have an unlimited amount of money and human resources; otherwise, then we wouldn't have any problem"	"If everyone is busy all the time, it kills innovation and creativity. (...) I don't have time to be creative. However, if people are not too busy all the time, if there are hours or even days with time for them to think, explore future trends, or consider how problems could be solved in new and innovative ways, that's good. (...)When someone finds a good tool or method, we share it, which further fosters innovation, creativity, and new ideas"
		Sustainability of labs (challenges to sustain projects linked to funding)	"It's common for projects to fade away shortly after completion, but we're actively working to prevent that"	"I have noticed that we have had small living labs or hubs here at KAMK, usually created during the project. But when the project ends, many times the activity also ends. So, there should be some kind of continuation. There should be funding and help from stakeholders who can benefit from it. Maybe the city of Kajaani could sponsor it."	"There should be future plans even after the project if the project is monitoring this type of creation so it can proceed and not just be lost at some point (...) But after that, when funding ends, there might not even be persons responsible for coordinating and developing it further."	