Strengthening Canadian Academic Entrepreneurial Ecosystems: A Living Lab Approach

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ABSTRACT

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Abstract: Canada's universities are facing unprecedented challenges due to new government regulations, the shift towards a more digital environment and the advent of new digital technologies such as generative AI in education. In order to respond to these challenges, most universities have now moved toward contributing to local and regional development to co-create local value. This can be done through innovation and entrepreneurial activities by universities. To promote entrepreneurship and innovation in academic environments, living labs (LL) have been identified as a possible solution as they bring in actors from all around an innovation ecosystem together to co-create value. In order to better understand the impact and the role LL can play in encouraging academic entrepreneurship the most up to date information was collected on the subject through a literature review that served as the theoretical foundation to conduct an exploratory qualitative case study in Canadian academic ecosystems to see how LL can be an answer to the challenges facing Canadian academic entrepreneurial ecosystems and how LL's were integrated into these ecosystems based on the five aspects of LLs which are real-life setting, co-creation, active user involvement, multi-stakeholder participation, and a multi-method approach. The findings of this study highlight the adequacy of LL as a way to fulfill the new mission of HEI's, the mixed impact the pandemic had on LLs, the facilitating role of digital technologies in LL and some best practices and challenges giving insights on how to best set up LL methodologies in academic entrepreneurial ecosystems with qualified leadership.

Keywords: Living Lab, Academic entrepreneurial ecosystem, Exploratory qualitative study, Digital Technology, Canada

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1. INTRODUCTION

Higher education institutions (HEI) have always had the mission to spread and create knowledge by serving as the knowledge centers of their communities. This is reflected by their two main missions: teaching and research (Keohane, 1993). As our societies evolve due to environmental pressures such as globalization, digitization, environmental issues and the rising number of conflicts around the globe creating worldwide and frequent unrest in student bodies, universities have had to shift their purpose by adding a third mission[1]. This mission consists of contributing to society in order to respond to the challenges facing society as a whole (Compagnucci and Spigarelli, 2020). Canadian universities are facing other unique challenges such as regulatory pressures, student enrollment decreases and knowledge creation competition, making the transition to the new mission increasingly important.

As society gets deeper into the digital age, technology's importance and use have increased and its role expanded. Universities are no exception and have followed the trend as the role of digital technologies gradually increased until the pandemic which forced technology into all the activities of HEI's. This sudden change pushed them to quickly adapt to a new situation leading to digitally enabled universities (Rof et al, 2022). In these digitally enabled universities, digital technologies (DT) are everywhere, and students interact with them daily showing the changes developed during the pandemic have lingered beyond the recovery.

An even more recent technological advancement challenging the role of HEIs is artificial intelligence (AI) and more importantly generative AI which has the potential to "create" and analyze knowledge at speeds that were previously unimaginable (Gimpel et al, 2023). The widespread adoption of generative AI by universities poses challenges related to ethics, data privacy, intellectual property, and compliance with evolving legal frameworks (Gupta and Nyamapfene, 2025). Universities must manage how to use this tool and how to integrate it into their practices. Failing to do so could lead to potential major issues as students and faculty use it without proper guidance, spreading potentially erroneous information, releasing intellectual property, confidential data etc. This technology is now also a major competitor to universities in the dissemination, creation and assessment of knowledge (Gimpel et al, 2023) and students

[1] In this study, I will refer to this mission as *the new mission* and the efforts linked to achieving this mission as *new mission transition*.

might increasingly see universities as a longer and more complex way to learn skills and knowledge required for professional development. Whether that is a correct assessment of the power and accuracy of generative AI is another question. However, it is undeniably putting more pressure on HEIs to evolve the way they carry out their missions to stay relevant as knowledge centers in an increasingly technologically enabled society. Universities will have to define the rules and regulations surrounding generative AI use in their work to keep their intellectual property safe and their position as a credible source of information. In many countries, other non-technology related rules and regulations are also emphasizing the importance of change in HEI procedures, this study will look at Canada who is facing unique challenges.

The Canadian government has been tightening regulations on international students coming into the country (IRCC, 2024), forcing Canadian universities to look towards new ways to attract students to keep their standings and reputation as some of the best in the world along with the large amount of funding provided by the higher tuition costs of international students (Barbaric and Jones, 2016). These new regulations are putting Canadian universities in a difficult position to address some of the required changes explained above. They will need to transform into modern, more relevant institutions aiming to have a regional, social and economic impact by becoming drivers of local economic growth and centers of knowledge transfer by creating, [2]facilitating or leading innovation and entrepreneurial activities. These necessary changes have brought to light "entrepreneurial universities" as a pathway for HEI's to get actively engaged in their region's economic and social development to fulfill their new mission (Rubens et al, 2017). For universities to complete this transition, multiple streams of literature have been brought up namely UIC (University-Industry Collaboration) (Huang et al, 2017), innovation management (Blass and Heyward, 2014) the triple helix model (Carayannis et al, 2012) or student-centered education (Brennan et al, 2014), but this research looks at living labs (LL) as a potential solution for universities to fulfill their new mission. LLs are defined as collaborative innovation ecosystems in real-life environments based on a systematic user co-creation approach that integrates research and innovation activities in communities and/or multi-stakeholder environments, placing citizens and/or end-users at the center of the innovation process (Enoll[2]). This definition shows the unique potential of living labs to directly include the users and actors of the ecosystem it operates in into the innovation process, rendering it easier to create a direct

[2] Enoll is the largest LL lab network in the world

social impact on the HEI's community. They differ from the other solutions identified as they are a more recent stream of innovation that takes aspects from all the other solutions identified and combines them into a new, more complete approach. LLs borrow the user-centered approach from student-centered learning, multistakeholder innovation from the triple helix model, and collaborative innovation from innovation management. Further justification of LL as an adequate answer to the challenges facing HEI's is in the following paragraph.

The previous paragraphs have made abundantly clear that universities are now being required to reevaluate how they operate and adopt a new additional mission to respond to societal, technological and regulatory changes. Canadian universities face the changes affecting universities worldwide but also additional unique challenges due to their good world rankings and the changes being brough on to their student body by local regulatory changes. New ways of innovating and creating knowledge are going to need to be adopted by Canadian HEIs to maintain their status and this research analyzed if living labs can be a potential solution. Research on LL in academic settings has mainly been done as case studies but there is a lack of alignment on living lab definitions, structures and outcomes resulting in a call for more research to be done on LL (Hossain, 2018) and especially in academic settings (Tercanli and Jongbloed, 2022). Alongside this, the rise of technology in academic settings, accelerated by the pandemic, has led to universities becoming digitally enabled (Tarkar, 2020; Haleem et al, 2022).

These challenges facing Canadian HEI's can be overcome by using LL to fulfill their new mission. By analysing what the literary and real-world status are on this subject, this research provides an answer to how Canadian HEI's are adopting LL to fulfill their new mission. This leads to the research question of this thesis: "How has the Canadian LL landscape evolved in the HEI context in the digital age?". The goal of this research question is to analyse how LLs have been adopted in Canadian HEI's and how this can be further leveraged for Canada to fully benefit from the benefits of using LLs within its universities.

To answer the research question, a theoretical foundation was first established, then a case study was done from which this research's findings were pulled to understand how Canadian HEIs can maximize the benefits of LL. The subject of HEI led LL has seen a drastic increase in the amount of research being done on it as a search of "living labs" on google scholar between the two timeframes of 2000-2021 and 2021-2024 yields 17,800 and 19,500 results respectively showing an increase in LL research as in three years more papers have been written on the subject than in

the twenty years prior. This large quantity of research has been summarized in two literature reviews performed by Hayter et al in 2018 and by van de Heuvel et al. in 2021. The literature review by van de Heuvel et al analyzes the 2000 to 2021 timeframe and most of the papers come from after 2010. The goal of this research was to update their research by looking at the 2021-2025 period, which is of particular interest as there has been a steady increase in interest for living labs and the role of digital technologies in universities increased during this period. More importantly, this period included the pandemic which forced everyone to come up with new ways to innovate, showing how vulnerable we are and how innovation and the creation of new solutions can save us from such dire situations. Coupled with this renewed motivation for innovation, HEI also had to adapt to becoming virtual which came with many challenges in the realm of digital technologies and pedagogy. This review provided a strong theoretical foundation and analysis of the current state of the literature on the topic of HEI LL. The two literature reviews also concluded with a call for more research to be done on this subject as there is still a lack of alignment on the best practices, the definitions and the role of digital technologies in HEI LL. These calls are answered through the updated literature review provided by this paper.
This research first established a theoretical foundation through a literature review, then a case study helped further answer the research question. Finally, the results from both parts were compared, leading to a discussion on how HEI can best integrate LLs into their innovation practices. The theoretical foundations on the subject are established in Annexes 2 and 3 (literature review methodology and findings), then to answer the research question, a case study was conducted on two different Canadian innovation ecosystems chosen based on diverse and convenience criteria (Seawright & Gerring, 2008; Recker, 2021). These ecosystems were selected for their unique set of characteristics regarding university size, city size, location, innovation performance, the existing relationships between ecosystem actors, and my access to interviews within these ecosystems. Explorative case studies have been the leading methodology for LL centered research as practice is ahead of the literature. To conduct this case study, secondary data analysis, observations and interviews of different actors at university entrepreneurial ecosystems in Canada were conducted to provide more information on how HEI LL are being run, the challenges they face, the role of digital technologies, how LL can help in the new HEI mission transition and how they have evolved post pandemic in Canada. This analysis enabled me to understand how LL methodologies can be applied in Canada to solve the

challenges facing universities. With the results of the literature review and case study, recommendations on how Canadian HEI's can best integrate LL practices were created as a potential roadmap for strengthening academic entrepreneurial ecosystems in Canada.
This research answers the call for more research on the subject of HEI led LL, provides an updated review of the literature post pandemic and analyzes how HEI can integrate LL into their operations to be able to face their challenges more adequately. These findings will help contribute to strengthening the Canadian entrepreneurial ecosystem.

2. BACKGROUND

2.1 Environmental Pressures

An important part of the motivation for this paper is the changes in the ways HEI have been delivering their missions due to the pandemic. Lockdowns and quarantine measures prompted universities across the globe to rapidly switch to online learning, and as pandemic-related disruptions diminished, universities did not fully go back to their pre-pandemic pedagogy. A mix of blended learning between online and in-person meetings emerged where the benefits of both can be exploited (Imran et al, 2023). Canada was no exception and HEI's across Canada now have a higher percentage of online learning options than before and even some fully online degrees. The shift of education towards a more digital approach has brough on the following changes: the learning pace is more individualized, in-person classroom time is decreased and replaced by online modules or practical learning applications, content is digitized, and evaluation criteria are based on knowledge application rather than knowledge capacity (Garcia et al 2021). In short, HEI switched from lecture-based learning to a problem-solving learning system where the emphasis is put on how to critically apply and use knowledge.
Following this shift towards a digital learning approach, this research aimed to understand if digital technologies play a role in LL. Digital technologies, which are versatile and disruptive technological innovations, such as smart devices, the Internet of Things (IoT), artificial intelligence (AI), augmented reality (AR) and virtual reality (VR), blockchain, and software applications (Timotheou et al, 2023) as well as the more common ones such as electronic systems, devices and resources that are now use every day such as phones, emails, video calling etc. These technologies have altered education in schools and academic institutions and become facilitators (Steininger, 2019).

More specifically and more recently generative AI poses a new set of potential threats and benefits to HEI as ChatGPT, the most used generative AI chatbot, has been named a 24/7 tutor, changing the way people view education in the span of a couple of months after its release (Wu, 2023). The power of generative AI to revolutionize learning is immense as it can create new course material, pedagogies and be an assistant to educators, students and researchers alike (Baidoo-Anu and Ansah, 2023) but it also has some limitations regarding the accuracy of some of the information generated and the presence of biases that have been inherently included in its reasoning due to the data used to train it (Baidoo-Anu and Ansah, 2023). The challenge for HEI is to effectively integrate these new technologies to prepare their students to use them in the professional world but also because they provide benefits to the HEI (Timotheou et al, 2023).

2.2 Academic Innovation

For Higher Education Institutions to become the center of knowledge production in digital societies, they need to transform how they do research by ensuring that their research findings can directly improve or impact society (Huang et al, 2017). This can be described as academic innovation which Blass and Hayward (2014) explained as following: "Research and the production of knowledge becomes innovation once the knowledge is applied in a new and novel manner to create a new outcome, and the intellectual property that accompanies such innovations is what adds value to industry and the economy" essentially explaining that pushing research one step further by getting it to have a societal impact or potential financial benefits is the key to research staying relevant in the digital age. The authors then go on to explain that in order for universities to stay relevant in knowledge societies, they need to innovate as information sources (internet, MOOCS, social media, research databases…) and content analysis tools (generative AI, LLM, Data analytics) are increasing and now majorly outpacing human capabilities. This idea of academic innovation; pushing research to have a direct impact, is the basis of the motivation for HEIs to increase the amount of innovation that can be produced which can be reflected through the addition of the new mission of universities. This paper analyzed how living labs can be an avenue for creating socially impactful research.

As mentioned above, living labs have been heralded as a potential solution for universities to fulfill their new mission. Recently, the idea of increasing the amount of cooperation between industry and academia has been trending upwards as our societies shift from industrial to

knowledge based and digitally enabled. This has led to the appearance of multiple innovation models where universities associate themselves with other actors to create a better innovation environment or process (Cai and Etzkowitz, 2020). Some examples of these ideas are the triple helix model which involves universities, government and businesses and has now been expanded to quadruple or even quintuple helix model where the media or citizens represent the additional fourth helix and the fifth is an environmental component (Carayannis et al, 2012). University-Industry Collaboration (UIC) was a precursor of innovation projects where HEI and businesses worked together (Barnes et al, 2002). Lastly the solution this paper looked at are living labs which are based on the open innovation concept developed by Chesbrough which he describes as "a distributed innovation process that relies on purposefully managed knowledge flows across organizational boundaries, using pecuniary and nonpecuniary mechanisms in line with the organization's business model to guide and motivate knowledge sharing" (Chesbrough, 2017). All these concepts show the interest there is in building processes where innovation is created by bringing multiple actors to the same table that previously have not worked together and who have not shared their knowledge, resources and talents with the goal of developing novel and improved innovations (Ciriello et al, 2018). Canada is no outlier, and its government has been pushing innovation forward in order to use their highly educated workforce to their fullest potential. They defined innovation as the 'key to competitiveness, productivity, economic growth, job creation and overall improvement of living standards (Government of Canada, 2021) and emphasize the importance of partnerships and bringing stakeholders from across the innovation world together to foster innovation ecosystems, reflecting the goals of LL. HEI are producers of innovation and the situation facing Canadian HEI is singular due to the laws being imposed by the federal government and the unique composition of their student body as explained in the following two sections.

2.3 Innovation in Canada

According to Statistics Canada, in 2023, Canadian universities represented 35% of the total research and development activities in the country, making them the largest contributor to R&D nationally (Statistics Canada, 2023). Universities's research activities represent the largest monetary value at around $17 billion. Within this activity, over 1 billion dollars was spent for businesses and almost two billion was spent for NGO organizations (Universities Canada, 2023).

“Research is essential to advancing society, strengthening the economy, driving innovation, and addressing the vexing and challenging problems we face as a people, place, and planet. It’s through research, scholarship, and discovery that we learn about our history and ourselves, understand the present context in which we live, and plan for and secure our future.” (Rosowsky, 2022). This entails that research and innovation are beneficial for universities and for society and that the two work hand in hand as research benefits society, and society provides universities with the resources it needs to produce research. It is thus in the best interest of universities to keep doing research to generate new ideas, concepts and push out new innovations. Likewise, it is beneficial for society to enable research through funding to reap the benefits of innovation and research. This proves that the new mission of universities to have a societal impact is being adopted by Canadian HEIs and it is showing signs of being successful as highlighted by the federal government’s commitment to innovation.

This idea of increasing the amount of cooperation that is happening between industries, governments and universities can be seen by the increasing amount of Science Parks, Innovation centers or incubators further showing that Canadian Universities are embracing their new mission. In Canada, the national statistics agency conducts a survey every year about how many companies benefit from accelerators and incubators nationwide and this number quadrupled from 2017 to 2019 before slowing its growth in 2020 due to COVID restrictions (Innovation, Science and Economic Development Canada, 2024). Living labs have also gained popularity as highlighted by Enoll which is the largest LL network worldwide who has, as of November 2024, 163 members in 37 different countries in 14 different sectors. Some more concrete examples of the interest in innovation and the creation of innovation ecosystems in Canada are the approval of Google company Sidewalk Labs by Canadian PM Justin Trudeau in 2017, designed to enable a technologically driven living environment (Hook, 2017). This highlights the importance of placing users at the center of innovation and the collaboration between governments and businesses. In Quebec, the creation of the Espace Aero, a $415M innovation zone created in 2024 and funded by provincial governments and corporations alike, highlights the importance of private and public sector cooperation to push innovation forward and to maintain a competitive edge over the rest of the world. This zone will be the fourth innovation zone in Quebec with the existing three concentrating on Quantum information, digital technologies and battery energy transition (Nerestant, 2024). It is clear that Canada is embracing innovation, and that HEIs need

to evolve and fulfill their new mission, but Canadian legislation and the demographic composition of student populations present distinct challanges.

2.4 Canadian Economic Considerations

The next factor of motivation for this research came with the situation of higher education in Canada who are currently facing pressure from the federal government regarding the heavy influx of international students that come to Canada to further their education. In 2020, almost 20% of the total student population in Canada was international. This has doubled over the past decade while the number of Canadian citizens enrolling in universities decreased during the same decade (Statistics Canada, 2024).

Canadian universities mainly rely on two sources of funding: student tuition and government funding. The share of government funding as a percentage of total revenue has been decreasing and dipped below 50% for Canada in 2019-2020 (Statistics Canada, 2022). This indicates that universities are becoming increasingly dependent on tuition fees to support their budgets. Given that international students typically pay higher tuition rates, they represent a more financially advantageous source of revenue for institutions. On top of that, in Canada, a large proportion of M.Sc. and Ph.D students, the students producing research and potential future academics, are international students. In 2023, all provinces had at least 30% of Ph.D students that were international students and 25% for M.Sc (Statistics Canada, 2023). This shows that Canada's higher education system relies on international students to fill in graduate studies openings and potentially become professors themselves, as Canadian academics who are foreign born represent an estimated 40% of all academics in the country (Barbaric and Jones, 2016). These professors provide valuable expertise and perspectives that Canadian HEI's have relied on to reach the high rankings they have today.

The three elements of research: professors, funding and graduate students in Canada all rely on international students to function. However, the Canadian government has recently been trying to cut down on the amount of international attention its universities are getting by reducing the amount of study permits given out in 2025 by 10% and then maintaining that same amount for 2026 (IRCC, 2024). The impact this could have on HEI is estimated to be at least a 50% decrease in enrollment of international students according to Universities Canada (Previl, 2024). Such a drastic decrease in international student enrollment could mean major financial losses for

Canadian universities across the country as on average in Canada, undergraduate international tuition was more than five times greater than citizen tuition (Statistics Canada, 2024).
All these changes in the Canadian HEI landscape have one common trait, they are reducing the number of international students that will enroll in Canadian universities across the country. This will heavily decrease the amount of funding universities receive and make it harder for universities to produce quality research to climb worldwide education rankings. Canadian students will also be impacted as they might have to pay higher tuitions or face a reduction in the quality of education they are receiving. In general, the whole Canadian higher education system will face challenges so Canadian HEIs need to find new ways to innovate and do research in order to keep their status as some of the world's best universities and continue to attract talent and be active actors in the communities. As mentioned previously, Living Labs could be a way to push innovation forward by using knowledge and resources that are already present but not yet linked together. This can create new revenue streams for universities all while strengthening and benefiting their local community and creating new avenues to attract local students through a more unique and purpose-driven approach to education. Some of the most valuable resources for innovation are creativity, ideas, knowledge, new perspectives and young minds and Canadian universities have access to some of the largest amount of these thanks to their immense student bodies. Being able to capture these ideas becomes the goal and living labs are one way to do this thanks to their user-centered and collaborative approach, bringing as many actors as possible around the table. Both these characteristics enable student participation in innovation, thus answering the question of how universities can tap into their wealth of innovative ideas present in their student bodies. This is how LL can be an appropriate solution to answering the call for increased innovation made by the Canadian government and help tackle the other challenges facing Canadian universities.

2.5 Answering the New University Mission

Living Labs are a way to bring together different actors of an innovation ecosystem to co-create value. This entrepreneurial solution could be used to transition to the new HEI mission as its outcomes lead to academic innovation and entrepreneurship by taking existing actors around the academic ecosystem such as research labs, projects, university incubators and actors outside the academic ecosystem but within the local innovation ecosystem (e.g., governments, private sector,

incubators, accelerators) and linking them together to co-create value. Through these new connections, the aim of the LL actors is to co-create value (i.e., creating more value than if each actor was working on their own) benefiting all the ecosystem, pushing it forward as a whole, which enhances their cohesion, collaboration and competitiveness, creating a virtuous circle. Another key aspect of LL is that they are focused on the users which means that they have a direct societal impact which is the objective of the new HEI mission (Dutileul et al, 2010). Through the previous paragraphs, I have shown that universities across the globe need to add a new mission to stay relevant and enable them to continue to improve society not just as knowledge creators but as knowledge and innovation facilitators, enablers and drivers. Thanks to their user centeredness, collaborative and co-creation aspects, living labs position themselves as appropriate ways for HEI to fulfill their new mission and bring together entrepreneurial ecosystems.

The following section establishes the foundation the case study is built upon. The outputs from both these research steps were used to develop the findings and recommendations presented in section 6.

3. LITERATURE REVIEW

The main objective of this research is to investigate how living labs (LL) can foster academic entrepreneurship and innovation within higher education institutions. Another objective is to find what the role of digital technologies is in HEI led LL considering the shift in educational practices caused by the pandemic, with the goal of helping Canadian universities transition to their new mission to address the challenges facing them. In order to better understand the concept of living labs and the goal of this research, the following definitions (see Table 1) are essential. Innovation ecosystems are the environment we will look at, value co-creation is the benefit of multi-stakeholder innovation, academic entrepreneurship is the way universities can perform entrepreneurship and integrate living labs into their systems, and lastly, digital technologies are of particular interest in the post-pandemic period.

Table 1: Living Lab Theoretical Foundations

Concept	Definitions
Innovation Ecosystem	Evolving set of actors, activities, and artifacts, and the institutions and relations, including complementary and substitute relations, that are important for the innovative performance of an actor or a population of actors. (Granstrand and Holgersson, 2020)
Digital Technologies	Electronic systems, devices and resources that assist us in performing daily tasks (emails, phones, cloud technology, video conferencing…)
Value Co-creation	An open innovation system that integrates knowledge, information and related skills in different institutional environments, and promotes multi-agent participation, which is an important basis for enterprises to obtain sustainable competitive advantages. (Ramirez and Garcia-Penalvo, 2018)
Academic Entrepreneurship	The establishment of new spinoff companies by faculty, postdocs, students, or affiliated personnel based on university technology (Hayter, 2018)

3.1 History of Living Labs

The first living lab project was started twenty years ago but the first mention of living labs in academic papers came only fifteen years ago which marks a five-year gap between practice and theory which emphasizes the practical nature of living labs since their beginnings (Ballon and Schuurman, 2015). This can be seen through their user-centered approach, real-life environment and multiple stakeholder involvement. However, even twenty years later, practice is still far ahead of theory as the number of projects keeps growing and the methodology is being adopted by diverse industries and universities, but the topic is still under-researched and especially how living labs can bring added value (Schuurman et al, 2015).

Living labs stem from four different concepts which are stigmergy, user-driven innovation, domestication of ICT and lastly open innovation (Ballon and Schuurman, 2015). The first concept of stigmergy originally came from biology to describe termite behavior. The word stigmergy comes from the ancient Greek words of stigma (mark) and ergon (action, work) and its meaning can be understood through this as it describes the phenomenon of addressing a complex issue through collective action through the process of one's person action leaves a mark and others are spurred on by this mark to follow the action towards the same goal (Pallot et al, 2010). User driven innovation was introduced by von Hippel (1998), domestication of ICT was introduced by Silverstone (1993) and lastly open innovation by Chesbrough (2017). By combining these four concepts, a living lab as a collaborative innovation space centered around users emerged.

The predecessor of living labs is cooperative design which can be traced back to efforts in Scandinavian countries to involve workers in the conceptual and implementation phases of IT projects in their own workplaces. In these scenarios, researchers and workers worked together to better encompass the worker's needs into the projects. This concept was then later pushed further into the ideas of trying to push innovation towards a direction determined by the user's wants and needs (Ballon and Schuurman, 2015). This evolved into UCD (user-centered-design) in which the user's necessities are given the utmost importance and is based on three different principles which are user focus, implementation of KPI and lastly iterative design (Gould and Lewis, 1985). At the same time the concepts of social experiments, i.e. the idea of bringing the experiment to people instead of the other way around, and digital cities gained popularity. Bringing all these ideas together, user involvement, real world environment, user centered approach and testing environments led to the creation of a loose concept of living labs which became an umbrella term to describe different types of research and innovation methods which can be broken down as followed (Ballon and Schuurman, 2015):

- **Urban Living Labs**: This type of LL is centered around transforming urban living spaces into data gathering centers where users are directly involved and are driving the projects. The aim is to develop, try out and test innovative urban solutions in a real-life context (Steen and Van Bueren, 2017). Some examples of this are smart or digital cities.
- **Research Living Lab**: These living labs focus on creating innovation through a living lab approach, so the term describes a methodology and does not need to be tied to a

physical space. This aligns with the European LL movement which uses the definition provided by EnoLL below.

- **Testbeds**: this type of Living lab focuses on the development of new technologies by placing them in a real-life environment and analyzing the public's interactions with it as well as their acceptance of it. Engels et al, (2019) defined them as "controlled experimental spaces that facilitate a kind of performance or hypothesis testing under presumably realistic conditions."

This research focuses on research living lab which are defined by EnoLL[3] (i.e., the largest living lab network in the world) as following: Living Labs are open innovation ecosystems in real-life environments based on a systematic user co-creation approach that integrates research and innovation activities in communities and/or multi-stakeholder environments, placing citizens and/or end-users at the center of the innovation process. This differs from the test bed and urban LL approaches and will be the version of LL that has been addressed in this study.

This definition has five important characteristics that will be used to identify how HEI adopt LL practices. The five characteristics are the following as proposed by the Enoll definition:

- User Involvement: to provide solutions that will directly impact the community the lab is taking place in, the users are at the center of the LL process to ensure their needs are met. This enables a constructive, short and direct feedback loop ensuring participatory design.
- Real-Life Environment: to provide solutions that will directly impact the community, it is important to be able to replicate or work in the environment the solutions will be deployed into to provide real-world validity and encounter any natural user behaviours or challenges during the innovation process.
- Co-Creation: multiple actors from different backgrounds working together will create more value than if they all worked separately. Value co-creation is the outcome of the living lab methodology.
- Multi-Stakeholder Participation: bringing actors from different parts of an innovation ecosystem ensures a larger knowledge and resource base enabling co-creation. Multi-stakeholder participation is the unique composition of the LL projects which enables value co-creation.

[3] https://enoll.org/

- Multi-Method Approach: Due to the diversity of actors different methodologies to tackle problems are used to provide innovative or unconventional solutions to problems.

LLs as user-centered open innovation ecosystems were created in 2006 and became popular when the European Commission began to integrate them into its innovation policies in 2009 (Dutilleul et al, 2010). This version of LL is still a very European centered approach and has seen heavy traction in Scandinavian countries as well as the Benelux countries where multiple universities and governments have successfully implemented long term sustainable living labs (Schuurman and Tõnurist, 2016).

In order to better explain what research LLs are, below is an example studied by Bartelt et al (2020) in Denver in which we can see the focus is on creating innovation to improve the user's life by bringing different actors to the table. In this project, living labs are used to address challenges of a rapidly growing city without the resources and facilities to welcome its new inhabitants. Denver' launched a smart city initiative in an attempt to use the power of digital technologies to answer some of its problems. Then, the Denver Living Lab (DLL) was introduced and works as following:

*The Denver Living Lab (DLL) functions as a live testing ground for smart city-specific with teams comprised of members from multiple city departments and external vendors. Each DLL project is centred around implementation and testing of a new innovation designed to improve city operation or service delivery. From the outset, DLL projects involve collaboration across departments and with external vendors, focusing on problem solving with a "failfast" and iterative workflow. With a "failing fast" and "failing often" mentality, innovative processes are encouraged with an understanding that many will not succeed. Not a lot of time is spent once teams realize the innovation will not work (*Bartelt et al, 2020, p. 3).

In this example, the five characteristics of LL proposed by Enoll can be showcased as follows:

- User Involvement: The solutions are directly aimed at improving the life of the citizens of the city, as they are directly submitted to the government.
- Real Life Environment: the city itself is the testing environment, ensuring the testing environment is identical to the one in which the solutions will be deployed.
- Co-Creation: Due to the diverse composition of the LL projects, they are able to provide solutions that encompass the expertise and specifications from government departments and outside vendors simultaneously.

- Multi-Stakeholder participation: The teams are composed of actors from different government departments (i.e., Transportation & Mobility, the Mayor's Office, Tech Services, and Environmental Health) and outside vendors.
- Multi-Method Approach: The iterative "fail-fast" "fail-often" methodology ensures a multitude of approaches are considered.A key aspect that also needs to be defined is how living labs differ from other common concepts in the entrepreneurial field such as accelerators or incubators. The key difference is that since this research is looking at living labs as a type of methodology, there is no need for a business plan or prototype to be involved in the process and at the end the commercialization of a product is not the goal. Living labs are a step before incubators and accelerators, they are where ideas are generated, and actors are brought to the table with a user centered focus. Once the idea or concept is set, the next step is to bring it to an incubator then an accelerator to have a prototyping process and hopefully a go to market strategy. Another unique characteristic of LL is that they are not only used for the creation of business or product. A LL can look for solutions, frameworks, ideas, concepts as well as business and product.

3.2 Academic Entrepreneurship

Academic entrepreneurship, the establishment of new companies or business endeavors by HEI faculty and students, and the problem it faces has been studied (Hayter 2016) and academics and public organizations have been asking for a more effective innovation approach centered around user needs while harnessing the knowledge of diverse actors (Trencher et al, 2015). Living-labs have emerged as an adequate solution to this demand and multiple LL have been set up in universities across the globe (Buhl et al, 2017). However, very few projects on living labs as a means of innovation and new mission fulfillment inside HEI have been done. On top of that, the role of digital technology in LL has yet to be clearly defined. The best example of living lab integration into HEI is written by Callaghan and Herselman, (2015) in which they full describe the structure, methodology and innovation process of an HEI LL in South Africa over 10 years ago. They describe the LL methodology as a dynamic, participatory approach that thrives on collaboration, real-world testing, and adaptive management. Success hinges on stakeholder engagement, clear governance, and alignment with broader socio-economic goals. The common challenges are institutional delays and effective resource management.

3.3 Digital Technologies

Digital technologies have become an essential part of the learning process in HEI especially after the pandemic forced an almost immediate switch to digital learning (Tarkar, 2020). This enabled the creation of digital classrooms where technology is the medium through which teaching and learning are done through online classes, online class calendars, virtual class sessions, online submission tools etc., creating a more interactive, relevant, inclusive, flexible and accessible learning experience making digital technologies facilitators of knowledge transfer in education (Haleem et al, 2022).

The digital learning experience has made learning more flexible meaning that professors and students are able to work more independently thanks to the flexibility of communication, collaboration and class times provided by digital learning environment (Kryukov and Gorin, 2017). This increased flexibility and change towards a more interactive and knowledge application pedagogy can make students and professors more available to take part in projects outside of traditional classroom activities.

In innovation, the exact role of digital technologies is unclear although there is clear evidence that their use in innovation processes is widespread and provides benefits (Urbinati et al, 2020) especially as facilitators (Steininger, 2019) or disruptors (Zahra et al, 2023). Digital technologies are now widespread enough that they will be a part of all innovation ecosystems and entrepreneurs should view them as any other tool. This means that digital technologies can become ecosystem disruptors, competitive advantages, production enhancers, advertising materials etc. It is important to know how entrepreneurs can respond to the digital technologies changes that are happening within their ecosystem (Zahra et al, 2023). A more precise look at how digital technologies affect open innovations processes once again reveals a “lack of specific attention to the applications, methods of use, and benefits characterizing digital technologies in open innovation processes’’ (Urbinati et al, 2020). Some studies even argue that the role of digital technologies in innovation is overrated as they are just like any other tool and unless they are a provider of a competitive advantage, they will not significantly boost innovation performance (Baia et al, 2020). In universities forced to switch online due to the pandemic, a decrease in relational and human capital could potentially be happening reducing the impact of innovation ecosystems as their actors lose touch with each other formally but more importantly informally (Usai et al, 2021).

With the lack of information on the role of digital technologies in innovation and in open innovation, LL follow the same trend, and no significant research has been done on how digital technologies impact LL (van den Heuvel et al, 2021). With the rise of digital technologies in HEI as facilitators and innovation coinciding with the lack of research on the role of digital technologies in innovation processes, understanding if and how digital technologies play a facilitator role in LL could help fill a large knowledge gap.

3.4 Living Labs in Academic Entrepreneurial Ecosystems

In order to establish a strong theoretical base, a literature review was conducted on HEI led LL to include the most recent studies in this area following the methodology outlined in Annex 1. As a result of the initial search, one literature review study conducted by van den Heuvel et al (2021) was identified. In order to identify studies published after this review, their methodology was copied but updated to 2025 to get the most recent findings on the subject. The full methodology and analysis of papers can be found in Annexes 2 and 3. From this analysis, the findings from the 2021 paper were compared with the sixteen recent publications to identify the changes that have been made in the living lab landscape. This literature review is organized based on the following topics which will serve as the guide for all the research being done in this paper.

The analysis was broken down into four different criteria essential to answering the research questions. The first criterion is if the paper mentioned a change or evolution in the LL practices due to the pandemic or changes from the pre-covid to the post-covid period. The second criterion was if there was any mention of the role that digital technologies play in HEI LL. The third criterion was if the research explained how LL can help HEI to transition to their new mission. Lastly, any challenges or best practices about HEI LL were identified.

These criteria helped determine how digital technologies are being used in HEI LL and the changes that have been brought to the subject post pandemic which should address the theoretical aspects of the research question: How has the Canadian Living Lab (LL) landscape evolved in the context of Higher Education Institutions (HEIs) in the digital age? In terms of practice, answers were gathered by looking at how these papers explore how LL can help answer the challenges facing modern universities and uncover some best practices and recurring challenges. The subsequent case study process was enriched with the findings from these papers.

Table 2 shows the identified studies mapped to each of the key criteria in the literature review coding process.

Table 2: Literature Review Coding Results

1. Pandemic period changes	van Engelenhoven et al, 2024; Maria Fernandes-Jesus et al, 2024; Urmanaviciene et al, 2022
2. Role of DT	Davidson et al, 2022 ; Maria Fernandes-Jesus et al, 2024
3. HEI new mission transition	Davidson et al, 2022; Maria Fernandes-Jesus et al, 2024; Tercanli et al, 2024; van Engelenhoven et al, 2022; Konstantinidis et al, 2021; Chapagain and Mikkelsen, 2023; Urmanaviciene et al, 2022
4. Challenges and best practices	Tercanli et al, 2024 ; Davidson et al, 2022 ; Maria Fernandes-Jesus et al, 2024 ; van Engelenhoven et al, 2022 ; Tercanli et al, 2024 (2) ; Schuurman et al, 2013 ; Schuurman et al, 2013 ; Davidson et al, 2022 ; Fernandes-Jesus et al, 2024 ; Konstantinidis et al, 2021 ; Chapagain and Mikkelsen, 2023

Following this breakdown of papers, section4 compares what they are saying to what was being said in the van den Heuvel paper for each criterion of interest as well as the definitions being used in all the papers (Table 3). The analysis of the definitions used in the paper will identify if the authors align on this subject.

Table 3: Literature Review Definitions Results

LL Definition	Davidson et al, 2022; Maria Fernandes-Jesus et al, 2024; Tercanli et al, 2024; van Engelenhoven et al, 2022; Konstantinidis et al, 2021; Chapagain and Mikkelsen, 2023; Leminen et al, 2012; Almiral et al, 2012; Tercanli et al, 2024 (2); Schuurman et al, 2013; Urmanaviciene et al, 2022; Hossain et al, 2019; Bergvall-Kåreborn and Ståhlbröst, 2009; Almiral and Wareham, 2011; Schuurman and Tonurist, 2016

4. EVOLUTION

This analysis of the evolution of the literature on the subject of HEI LL first starts with a short summary of van den Heuvel et al (2021) in the following sentence**.** This paper is a scoping literature review with the goal of answering the research question "What is known about the role of higher education in living labs in scientific literature and about the factors that influence integration of higher education and living labs?"**.** The conclusions that can be drawn from this research are, firstly that research on the inclusion of LL into HEI is still in its infancy and further studies need to look at the effects of these initiatives on learning outcomes for participants and the effect they have on educational activities. Additionally, there are gaps in the literature regarding the governance, conditions, structures and organisation of HEI LL initiatives. The full review of van den Heuvel paper is presented in Annex 3. The following six sections outline the evolution between the findings presented by van den Heuvel et al. in 2021 and the updated findings provided in this paper's 2025 literature review.

4.1 Definitions Comparison

Moving on to definitions, van den Heuvel et al (2021) agrees that LL are increasingly gaining popularity as the years go on and they use the definition provided by Enoll to define the LL concept, similarly to what has been done in this paper. However, they highlight that this is not a universal definition and that every LL incorporates the important aspects of LL (Real life setting, user involvement, multi method, multi stakeholder and co-creation) in different ways with varying degrees of importance. This is similar to this research's analysis of the definitions. Van den Heuvel et al (2021) then explains that even though there is still a lack of alignment on the LL concept and that the successful execution of LL endeavors is still not clear, more and more research is being done on the subject, and it is on the right track towards becoming a more established and mature research subject. However, they explain that there is still a clear lack of research on how to integrate LL into HEIs which is still the case as highlighted by the small number of papers found during the more recent period analyzed.

4.2 Post Pandemic Changes

Since none of the papers compare pre and post pandemic LL practices, it is difficult to have a clear subject that can be analyzed to determine concrete changes. This means that the analysis of pre and post pandemic changes is made from looking at different statements from all of the post-pandemic papers. The first pandemic change is the increased presence of digital technologies in HEI LL practices. As academia was forced to go online, LL were forced to adapt (Davidson et al, 2022) to online delivery and some of the new technologies adopted such as video conferencing, mind mapping tools, collaboration tools stayed in use even after the pandemic Maria Fernandes-Jesus (2024). The second change is the increased interest in LL and in being able to teach more professionally relevant skills to students. The pandemic put into perspective the historical role and functioning of universities and students also became less fond of the traditional academic approach. This has resulted in the need for newer more interactive pedagogies to motivate and integrate students and LL are a great way to do this. The pandemic was also a catalyst for the adoption of LL as there was a renewed interest in innovation and collaboration with actors close to you (Urmanaviciene et al, 2022).

4.3 Role of DT Comparison

Van den Heuvel highlights the fact that the role of digital technologies in LL and more specifically in HEI led LL is still unclear apart from being a facilitator and more research needs to be done on the subject echoing Urbinati et al (2020). In the updated literature review of 2025 provided in this paper, even though there is a mention of technology serving a facilitating role by two papers, no new consensus on the role of digital technologies in HEI LL has been addressed.

4.4 HEI New Mission Transition

The LL outcomes unearthed by van den Heuvel et al (2021), align with the outcomes from Davidson et al, (2022) and Chapagain and Mikkelsen (2023). In terms of reinvigorating learning practices to increase student participation. Van den Heuvel et al (2021) aimed to explore how education contributes to living labs and how learning is designed within these environments. The researchers examined whether articles addressed learning outcomes, teaching activities, and assessment methods in living labs. Out of their 21 articles, 14 discussed student learning outcomes, categorizing them into “generic” (soft skills) and “discipline-specific” outcomes (hard

skills). Teaching activities included innovative methods like "fun learning" (e.g., cartoons, gaming), participatory approaches, and student-driven projects. Assessment of learning was rarely discussed, with only three articles mentioning methods such as presentations, reflections, peer reviews, and exhibitions. One article noted that living lab assessments tend to be less competitive compared to traditional curricula potentially highlighting a flaw in using LL as academic for credit courses. Overall, the study highlights the potential of living labs for fostering experiential, collaborative, and student-centered learning, though more research is needed on assessment practices as highlighted by some of the papers looked at in the updated version (Tercanli et al, 2024; van Engelenhoven et al, 2023).

This paper's introduction echoes van Engelenhoven (2023), Urmanaviciene et al (2022) Konstantinidis et al (2021), van den Heuvel at al (2021) and others in the fact that the new challenges facing our societies need new solutions that are collaborative in order to be answered as stated in the section on how to address the new mission of universities. There are skills that need to be taught to new and experienced workforces to address the challenges and employees now need to be lifelong learners in order to be successful as the workforce has evolved and is now demanding different skills from what universities can provide as highlighted by Davidson et al (2022) and Chapagain and Mikkelsen (2023). This means that both students and professionals, regardless of the field, can benefit from partaking in LL projects. Additionally, van den Heuvel states that students do not appreciate the traditional university approach and academics argue that HEI do not prepare students correctly to answer the demands of the workforce which has now evolved beyond what universities taught, showing they are behind industry trends. In order to resolve this, HEIs need to adopt a process of incorporating research into education and education into practice to better match student's preparations to the demands of the workforce and this can be done in LL. This idea that LL can provide students with a more workforce transferable skillset is shared by Davidson et al (2022) and Chapagain and Mikkelsen (2023).

4.5 Challenges and Best Practices

According to van den Heuvel et al (2021), the success of living labs depends on effective interactions and effective initial set-up which is confirmed by Tercanli et al (2024) and Maria Fernades-Jesus et al (2024). The interactions between actors benefit from clear role acknowledgement in order to reduce competitiveness and pressure amongst stakeholders.

Technologies such as social media, blogs and networking platforms enhance the success of interactions between stakeholders, which is similar to the findings from this paper's literature review.

Some key challenges are balancing the difference between the traditional structured and planned nature of HEI with the unpredictable and dynamic aspect of LL as they are polar opposites, and this unpredictable factor is essential to LL success along with openness, flexibility and adaptability as similarly stated by Tercanli et al (2024) and Urmanaviciene et al (2022). Another key challenge is to ensure valuable and effective relationships are created between actors in the LL and that everyone is in a lifelong approach to learning mindset in order to align differing stakeholder expectations and knowledge levels to avoid teacher-student dynamics and other hierarchical structures. These best practices are similar to the results from the literature review but the challenge of HEI breaking away from their siloed and rigid structure to adopt a more flexible approach is something that universities became more familiar with as they learnt how to deal with the rapid changes caused by the pandemic. More research by Tercanli et al (2024) has also been done in order to better define the organizational and managerial requirements required for successful LL implementations explaining that managers must be dynamic, adaptable, backed by the HEI and excellent communicators.

4.6 Summary

Overall, the research by van den Heuvel (2021) underscores the need for further research and theoretical development to fully understand how to integrate LL into HEIs. By updating this research it is firstly clear that for definitions, the one provided by Enoll is the most used as it includes all the important aspects of LL, showcasing the beginning of a theoretical alignment. For the first criterion, the pandemic showed universities need to have a more dynamic and less hierarchical structure as well as a different approach to research that more directly influences its community. This made the drastic changes caused by the pandemic a catalyst for the adoption of LL to answer the new mission of HEI and to adopt more digital technologies in order to improve communications and knowledge sharing practices Urmanaviciene et al (2022). For the second criterion, van den Heuvel et al had already identified the role of digital technologies as a facilitator of collaboration and Davidson et al (2022) and Maria Fernandes-Jesus et al (2024) echo this finding explaining that the ability to break down physical barriers, simultaneously

collaborate and communicate more easily are changes brought on by the pandemic that sticked beyond the pandemic period. For the third criterion of the potential of living labs to answer the unique situation facing HEI, both papers from before and after 2021 agree on the fact that LL are an effective way to transition to the modern three mission HEI (van Engelenhoven (2023), Urmanaviciene et al (2022) Konstantinidis et al (2021), van den Heuvel at al (2021)). For the last criterion of challenges and best practices, there has been more research (Tercanli et al, 2024 and Urmanaviciene et al, 2022) published to improve the understanding of the governance and organization needed to successfully set-up and manage HEI LL and the relationships between actors in the lab which answers the call made by van den Heuvel et al (2021) to get a better understanding of how to create success in HEI LL.

One key aspect that was previously overlooked and might have more implications is the ability of living labs to more effectively teach students professionally transferable soft and hard skills than the traditional HEI approaches (Davidson et al, 2022; Chapagain and Mikkelsen 2023). Another important point that arose in the literature review is the importance lab managers play in creating success (Tercanli, 2024). Managers that are adaptable, good communicators, subject experts and are backed by their HEI will see the most amount of success. Overall, the literature review shows that the pandemic was a catalyst for change in HEI and favored the adoption of LL initiatives. The role of digital technologies still needs more research to be done in order to see if it can expand beyond just being a facilitator. All the literature backs the fact that universities need to adopt the new mission, and that LL can be a means to do so. Lastly, for challenges and best practices, the importance of having a good manager seems to be the most important factor leading to LL success.

5. METHODOLOGY

In this research, an empirical study on the experience of diverse actors of HEI LL at Canadian universities was conducted through secondary data analysis, interviews and observations. All data collected through observations and interviews was done following the university ethical guidelines. This enabled me to gather information on the topics of interest, and most importantly, to gain information on how this subject was being addressed in Canada. (Evans et al, 2015; Conruyt et al 2015).

The case study was structured in three parts with the first part being an analysis of secondary data on the units of analysis based on the literature review conducted previously. The second part was centered around getting primary data from interviews and observations of different actors in innovation ecosystems. The final part of this research was to compare the findings from the primary data analysis to the findings from the secondary data analysis and literature review to allow for a comparison between theory and practice on the subject of HEI led LL.

Qualitative research is appropriate for this study because of the exploratory nature of the research question and the complex nature of integrating living labs into HEIs (Recker, 2021). In order to better inform this paper's case study, the findings from the literature review as well as an analysis of secondary data from each of the ecosystems of interest were used to better understand them before conducting interviews and observations. The secondary data analysis focused on analyzing data for each of the topics from the literature review coding process for each innovation ecosystem. This process ensures that the coding process is a common thread that stays present, guiding to more accurately comparable results between the literature review and case study of this research, thus enabling triangulation.

Since this project is exploratory research on an emerging topic, a case study was the right fit to gather data to answer the research question as it looks at complex processes with multiple actors working together on very large scales. A multiple-embedded case study was conducted (Recker, 2021) where two different innovation ecosystems were compared with the different ecosystem actors being part of the data collection with a deeper look at HEI's as units of analysis in order to answer the research question. Furthermore, the multiple case study approach has been one of the leading methodologies used to define LL process, integration into HEI and challenges and best practices (Almiral and Wareham, 2011, Chapagain and Mikkelsen, 2023, Callaghan and Herselman, 2015). As it is now clear this is an appropriate approach to studying living labs in academic settings, the next paragraphs give a brief overview of the innovation ecosystems analyzed in this research.

The first identified ecosystem (E1) is located in Quebec in a large city that has multiple large universities (over 30,000 students).

One of these universities is the university of interest (U1). This university is a large public university with four faculties offering a diverse choice of studies. Around 25% of its population is international. I chose this university for its large size, high international student percentage,

innovation performance, location and convenience reasons as the relationships I have in it would not be replicable in other universities.

Ecosystem number two (E2) is located in Ontario in a medium sized city (above 100,000 inhabitants) that has three HEI, one of large size (U2), one of medium size and a smaller college (less than 2000 students). U2 was selected as it is the largest university which enables it to take part in a lot more innovation initiatives than its ecosystem counterparts. In terms of innovation, E2 has been praised as the best small city for small investments and boasts one of the most educated workforces in Canada according to statistics Canada. E1 has, like most large cities, a good ranking for innovation and U1 has many initiatives centered around innovation.

The interviews were a mix of descriptive and explanatory interviews attempting to understand the roles of the interviewees, how their projects tied into the greater innovation ecosystem by following the predefined coding process. The interviews conducted were semi-structured, meaning the interviewees were provided with a main list of questions and topics ahead of time (See Annex 4), but the conversations were flexible to allow for follow-up questions and discussions. Direct observations were also gathered by attending weekly meetings to understand the progress and processes of some of the LL approaches being done in one of the ecosystems. With the permission of participants, the interviews were recorded and transcribed in order to keep an accurate record of the data.

To analyze the primary data gathered from interviews, the same deductive coding approach used in the literature reviews was replicated, enabling triangulation and increasing the validity and reliability of this case study's findings (Recker, 2021).

Each ecosystem was first analyzed separately following the coding process using the same four codes of the literature review (Post pandemic changes, Role of DT, HEI new mission transition and Challenges and best practices) which were identified from a review of the literature and the most common topics in HEI LL research. These criteria provided the structure needed for the deductive coding approach used to analyse and reduce the data.

All the transcribed interview data was then attributed to a corresponding code. This enabled a first data reduction as all irrelevant or redundant data was not attributed to a code. Below are two examples of deductive coding used in this research.

Table 4: Primary Data Coding Examples

Quote	Code
E2 Municipal Government Official: *"Covid was a major disruptor in our community but for our innovation practices, it just reinforced the idea that we were on the right path"*	Post-Pandemic Changes
E1 Innovation Lab organizer: "*The students find that they're able to collaborate more efficiently by using messaging apps and document sharing platforms."*	Role of DT
E1 HEI Innovation Lab student: "*by participating in the innovation lab, I can learn more about what goes on in the professional world and I feel more ready to start my career than if I had only taken classes"*	HEI new mission transition.
E2 Municipal Government Official: *"For the projects to have the highest chance of success, finding the right team members is essential"*	Challenges and Best Practices.

- Once all primary data was classified based on the codes, thematic grouping was done as the last step of data reduction which led to a summarized understanding of the innovation ecosystem analyzed. To better understand the data, figures representing the innovation ecosystem were created and an analysis of how well each ecosystem integrated LL practices was done. To determine how the ecosystems integrated LL practices, the five components of LL provided by Enoll (i.e., User involvement, Real-life environment, Co-Creation, Multi-Stakeholder Participation and Multi-Method Approach) were used as the coding criteria. The same deductive coding approach was used, and each ecosystem was given a measure (high-medium-low) of how well they integrate the different LL criteria.

Table 5: Living Lab Characteristics Integration Examples

Quote	Characteristic
E2 Municipal Government Official: "*We foster innovation by holding annual competitions where citizens can pitch their ideas to the government"*	User Involvement
E1 Innovation Lab Student: *"All of the projects we do are set in the university's environment"*	Real-Life Environment
E2 Municipal Government Employee: *"By giving the resources (municipal data) on an open access platform, we are able to get so much more out of them than if we kept them to ourselves."*	Co-Creation
E1 faculty member: *"I never work with people outside of the university because it is already hard for me to know everything that is going on within the university"*	Multi-stakeholder Participation
E1 Innovation Center: *"We try to work with people who have different backgrounds because they'll be able to provide a point of view we can't"*	Multi-Method Approach

To ensure the reliability of the data, a peer review process was conducted where 25% of the secondary data and interview data was analyzed by a graduate research assistant to see if they came up with similar conclusions (Recker, 2021). The peer review was organized as follows:

- Training: Three 1:30h meetings were conducted with the first meeting used to familiarize the graduate research assistant with the subject, the second used to explain our research and methodology and the third one to explain our coding process and how it fits into the general research.
- Analysis: The graduate research assistant is given 25% of data selected at random.
- Findings: the findings reported by the graduate research assistant are compared to the findings identified by the researcher in this project with the objective of having the highest similarity between the two and addressing discrepancies.

The peer review resulted in a 95% similarity rating, further increasing the reliability of the findings. To further increase the validity of the findings, a diverse set of sources for secondary

data was selected as shown in Table 4, thus enhancing construct validity. Another action taken to reinforce construct validity was to establish a chain of evidence by recording interviews and taking written notes. For external validity, as the sampling of the data is not fully random, generalizations can only be done for similar economies and universities that are facing similar challenges to Canada. Looking at internal validity, this research attempted to minimize the number of confounding variables to increase internal validity (Yin, 2009). The first action taken was to ensure that all the interviews were conducted in the same year and that our interviewees were not interviewed more than twice to diminish the risk of them becoming familiar with the interview questions. All of the interviewees willingly participated in the research and very little to no contact was made with them before the interview in order to diminish the chances of introducing biases or having answers tailored to the goal of the research. This research also follows a pattern matching process which can be a way to increase internal validity (Yin, 2009). Thanks to the literature review done previously, the practical findings were compared to the theoretical assumptions as highlighted in the discussion section. Furthermore, through the comparison of the two cases this research looks at, underlying factors leading to academic innovation performances using LL methods are identified and an explanation for these results is presented. This process follows the steps of explanation building which also increases internal validity (Yin, 2009). The last step taken to ensure internal validity was to design logic models for the cases analyzed as well as the explanation of the results which are represented in Figures 1 and 2. This shows diverse actions taken to ensure the validity and reliability of the findings. Once the case study data was analyzed and the adequate measures were taken to ensure its validity and reliability, the results and findings were used to develop a potential avenue for solving the issue facing Canadian HEIs by strengthening academic entrepreneurial ecosystems. By identifying the gaps in LL adoption following Enoll principles, gathering the ideas for improvements proposed by the ecosystem actors during interviews and the analysis of the strengths and weaknesses of each ecosystem, a pathway to strengthening academic entrepreneurial ecosystems was developed and proposed in section 6.10 based on the combined results of the case study.

5.1 Data Selection

The first step for data selection was to find the ecosystems for this research. A preliminary analysis of secondary data on academic innovation was performed to understand the concepts that are used in this research and to understand how this was reflected in Canada. Following this preliminary analysis, the ecosystems were chosen for this research based on their location, their high innovation performance, the inclusion of HEI into their innovation practices and the access to the ecosystem actors of interest. Based on these criteria, two ecosystems were identified.

The data selection for this research was broken down into two parts. The first part was a secondary data analysis[4], and the second part was a primary data analysis done through a case study. The following paragraphs will explain the data selection process.

To inform the case study, secondary data was looked at to gain more insights into the topics identified in the literature review following the topic separation logic provided by the coding process as following:

- Pandemic Period Changes
- Role of DT
- HEI New Mission Transition
- Challenges and Best Practices

Based on some of the literature review findings, a deeper look at the roles of managers inside of ecosystem was done as it was made abundantly clear in the literature that managers play an essential role in coordinating the labs and ensuring the interactions between stakeholders are effective, respectful and constructive leading to LL successes.

To gain a better understanding of the impact of the pandemic, role of the digital technologies and managers as well as best practices and challenges in HEI LL, an analysis of secondary data for each ecosystem was conducted. To initiate the data gathering, an analysis of the websites of U1 and U2 was done by navigating to their innovation section from which the different initiatives they have or are partners with could be identified. Once these activities were identified, they were analyzed more in depth either on their websites or by looking at content created on them (news articles, podcasts, audio-visual, research papers). Through this search, one piece of content

[4] The secondary data analysis does not provide an analysis of the integration of the 5 LL criteria because the secondary data is used to inform the primary data collection by providing a high-level understanding of the two ecosystems of choice.

for each ecosystem that addresses each of the areas of interest based on the coding protocol designed in the literature review was identified and selected for analysis.

For E1, an academic paper describing the innovation ecosystem before the pandemic with a specific focus on technology through smart cities and a campus tour of U1 with a focus on all the diverse innovation activities happening were selected to gain an overview of the organisation of the ecosystem. Then to understand the role of innovation ecosystem managers, an interview from the head of the province's innovation council of E1 was selected. Finally, to understand best practices and challenges, documentation on an HEI LL that was a part of U1 with a physical space from 2020 to 2023, when it had to close its physical space due to financial challenges, was analyzed.

For E2, documentation on the city's Innovation Challenge being held in E2 for almost 10 years was the first selection. In this challenge, students or recent graduates are invited to pitch their ideas for improving the life of their fellow citizens to a panel of judges from the three universities and the mayor's office in order to access funding and help from the municipal or provincial government. This can enlighten this study's evaluation of how collaboration between actors is done and the role managers play in these collaborative efforts. Since this challenge has been happening before, during and after the pandemic, identifying potential adaptations or changes that were made to adapt to pandemic changes was possible. Next, an interview with the CEO of the city's economic development corporation gave insights into how the ecosystem is managed and the relationships between all of its actors. Lastly, an analysis of the city's community data project through which in depth census data can be visualized, analyzed and used to take data-driven decisions was conducted, thus addressing the DT component.

The following table highlights the different secondary data selected for each of the ecosystems of interest.

Table 6: Secondary Data Sources:

Topic	Ecosystem	Data Source
Role of Ecosystem Manager	E1	Video interview with the province's innovation manager
	E2	Video interview with the CEO of the city's economic development corporation
Pandemic Changes	E1	Academic paper and U1 Campus tour
	E2	Innovation Challenge documentation (website and social media)

Role of DT	E1	U1 Campus tour podcasts
	E2	Documentation on the city's community data project (website)
HEI New Mission Integration	E1	Academic paper and U1 Campus tour
	E2	Innovation Challenge documentation and city's innovation website
Challenges and Best Practices	E1	Documentation on an HEI LL closed due to financial challenges (online)
	E2	Video interview with the CEO of the city's economic development corporation and related news articles

For this research's primary data selection, the two ecosystems were first identified as explained previously and then actors from each of them were identified and contacted for interviews.

The selected interviewees were members of the innovation practices identified during the secondary data analysis so that a deeper dive into information and topics already analysed could be done, thus enabling me to drill down to gain valuable topic specific insights thanks to the coding process identified.

In E1, interviews and observations were conducted with actors from an innovation centre and an innovation lab using a living lab methodology both linked to the HEI, students from within both these initiatives, members of a non-HEI related innovation centre and faculty members. In E2, interviews were conducted with a municipal government official tasked with developing innovation, members of his team with a focus on technology, and a member of a non-profit whose goal is to increase economic development within the city. Overall, 22 hours of data collection through interviews and observations contributed to the primary data collection phase of the study. Table 5 showcases the actors interviewed in both ecosystems as part of this study's data collection.

Table 7: Primary Data Sources

Ecosystem	Actor	Data Collection Method	Time
E1	HEI Innovation Lab Leader	Interviews and Observations	3H
E1	HEI Innovation Lab Students	Interviews and Observations	6H
E1	HEI Innovation Center Students	Interviews and Observations	2H
E1	Faculty Members (2)	Interviews	2H
E1	Innovation Center	Interview	1H

E1	Municipal Government Official	Observation	2H
E2	Municipal Government Official	Interview	2H
E2	Municipal Government Employees (2) (technology focus)	Interviews	2H
E2	Non-Profit Leader	Interviews	2H

Throughout these interviews, the first goal was to map out the two innovation ecosystems in order to understand their structures, the actors present and the relationships tying them together to enable me to then conduct a better comparison. Once the ecosystems were understood, I looked to gather more information following the coding groups from the literature review and secondary data analysis (Role of DT, HEI new mission transition, role of lab managers, post pandemic changes and best practices and challenges). This coding process ensured that we could get construct validity into our research. As the topic of living labs and entrepreneurial academic ecosystems are quite complex, we attempted to get answers on the subject through asking questions relating to our coding process which encompasses subjects that are much easier to understand. Once this primary data was collected and analysed, a look back at the secondary data was done in order to ensure the analysis echoed the same ideas as the secondary data. This was then used to craft section 6.9 outlining potential solutions to the situation facing Canadian HEIs.

6. RESULTS

6.1 U1 and E1 Secondary Data Analysis

After analyzing the secondary data analysis of the data from U1 and E1, the findings suggest that within U1 and E1 there are many innovation activities present with different focuses such as creating art, promoting entrepreneurship, helping the elderly, scientific research, with all of them using social innovation and some more specifically using LL as their innovation methodology. Next, when looking at what is happening in the other universities in E1, a lot of them have a similar situation where many innovation initiatives are happening within their walls. Furthermore, for the role of digital technologies, I can see that all the universities are focusing on producing research and creating labs centered around technological innovation or the integration of technology into other domains such as art or medicine. However, U1 is not the one who has the most initiatives centered around technology. In terms of management, it seems abundantly

clear that the province is promoting innovation throughout its territories by organizing different seminars, workshops, grants, research programs etc. However, there is no mention of city centric strategies or innovation ecosystem organizer. This could explain the lack of alignment of innovation projects that seems clear when looking at secondary data in U1 and E1. More insights into how the innovation ecosystem is organized inside the university and how it fits into the city's ecosystem will be an area of focus for the interviews. Another area of focus will be if there are "innovation managers" inside of E1 who could potentially provide this essential alignment needed for successful multi-stakeholder innovation. More information was gathered on how the actors are linked together and if the managers of all these actors interact in specific ways during the primary data analysis.

6.2 U2 and E2 Secondary Data Analysis

When looking at E2 and U2, a clear organization of the innovation network in the city is visible with all the major actors (i.e., municipal government, businesses, academic institutions) having a dedicated head of innovation. When looking at digital technologies, the municipal government works on different initiatives on collection and distribution of usable, updated and accurate data to its citizens to give them the power to leverage data to make more informed decisions. However, in terms of other DT, there is still a lack of research. The local government innovation challenge gives insights on how the city effectively includes its citizens and students in its innovation practices, thus tapping into their largest source of dynamic, forward looking and educated demographic group to improve the lives of the city's citizens that happens as a result of the collaboration of all of the ecosystem's actors. The goal of the interviews was understanding more about how the collaborations between actors are set up and what the roles of the actors are in this ecosystem that, at first glance, looks to be doing good innovation wise.

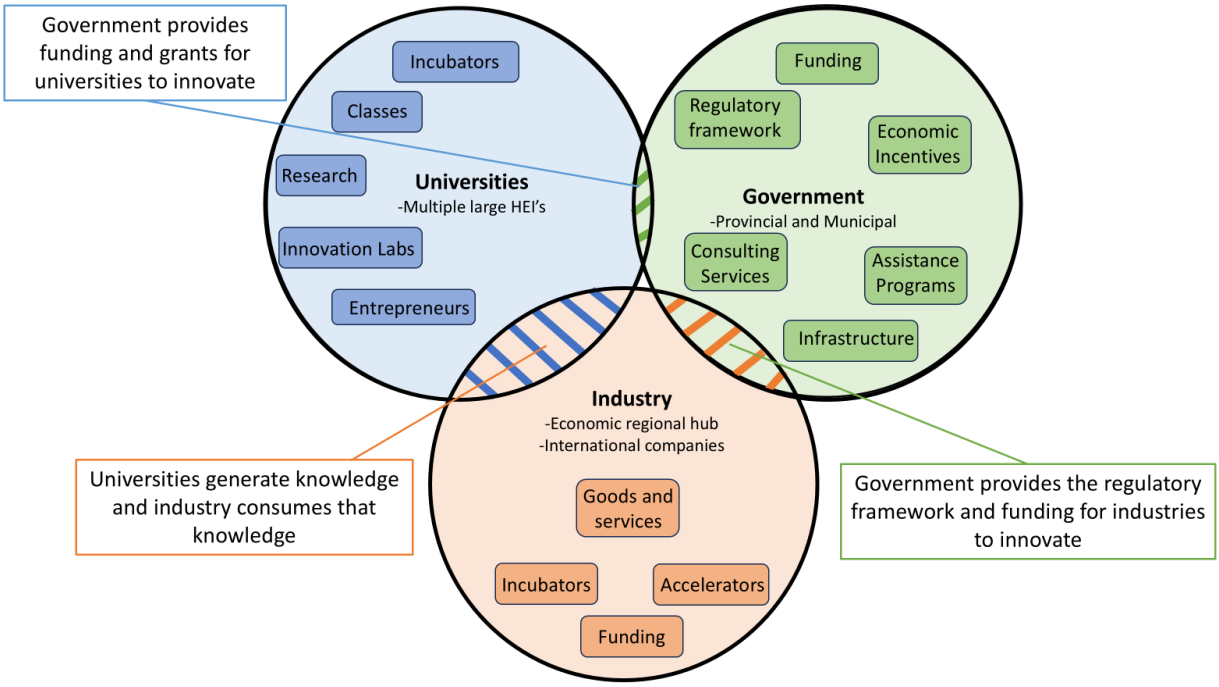
To summarize, when looking at the results from the secondary data analysis, more information needs to be gathered on the mapping of both E1 and E2 and the collaboration between the actors. The primary data analysis provided by the interviews helped understand the interactions between actors better and enabled the creation of diagrams that visually represent the collaborations (Figures 1 and 2)

6.3 E1 Innovation Ecosystem

Based on the collected data in this study, Figure 1 represent the structure of innovation of E1. Each actor of the ecosystem is represented by one large circle within which its characteristics are included. The overlap areas represent the collaboration between the different actors.

- Universities: Their resources are their faculty and students who have brain power to come up with ideas and develop projects based on them. The schools also have innovation resources within them such as incubators, innovation labs or accelerators. They produce research as their knowledge output.
- Government: They provide the framework, infrastructure and regulations needed for the actors to operate in the ecosystem. They also provide help to other actors through funding, expertise or consulting services.
- Industry: Their resources are their industry knowledge and connections brought by their experience. They also encompass incubators and accelerators that have a goal of bringing entrepreneurs towards profitability or market. Lastly, their output is goods and services that can be used by the other actors of the ecosystem.

Figure 1: U1 Innovation ecosystem



This figure represents how the different actors of E1 interact with each other. We see that each actor collaborates with the other two separately. Universities provide industry with the knowledge and employees they need to flourish. Conversely, industry produces the goods and services that universities use to produce their knowledge. Governments provide the regulatory framework and guidelines used by both universities and industries to conduct their operations. Governments also provide funding and opportunities for universities to help conduct their research. One key characteristic of this figure is that there is no overlap between all three circles signaling a lack of multi-stakeholder innovation.

Due to the large scale of U1, it benefits from environments that possess key aspects of successful innovation. There is a plethora of creative minds due to the large faculties and student bodies of the other universities in the city. The city is big enough to attract the world's biggest companies, thus offering the high-quality business actors. The provincial government has committed to innovation and the city's vibrant innovation ecosystem shows the public sector's commitment to innovation.

When looking more in depth at Figure 1, the number of collaborations between actors is low and never includes all three actors. This is the opposite structure of ecosystems using the Living lab

methodology. Through the interviews conducted for this research, answers to why there is little collaboration between the actors were found.

Faculty members from U1 involved in innovation practices in the ecosystem gave more insights on why it is difficult to conduct multi-stakeholder innovation following LL principles in E1. They explain that there are a lot of resources within E1, but not enough to feed the many projects within it, resulting in a competition for funding which is contrary to the collaborative multistakeholder innovation practices required to answer today's challenges as highlighted by the literature review. A faculty member explains "*Because all the other universities want funding from the government, every dollar from the government is gotten competitvely and it already requires resources to be able to win government funding*". However, the interviewees argue that the ecosystem is dynamic and vibrant which can explain its good rankings in terms of innovation, but this is done outside of U1. Based on the secondary data research, it is clear that there are many innovation initiatives at U1 ranging from research living labs, test beds, incubators, maker spaces, testbeds and the campus is being turned into an urban LL in the upcoming years but there is no coordination between all these efforts. A faculty member from U1 explains "*most of the innovation practices being done here (U1) resulting in change are pushed by internally motivated and driven individuals working together informally*". The faculty members explains that they leverage U1 students, facilities, and courses to advance their initiatives; however, they do so without a high level of support from the university or access to its institutional resources. The informal level of innovation is more effective because it can escape from the siloed, planned and rigid hierarchy typically found in HEI and governments (Tercanli et al, 2024). Furthermore, the goal of these projects is to fail fast and fail often which makes it difficult to fund them as success does not come often. A member of an innovation initiative at U1 mentions "*Because students are usually only with us for a single semester, we can't afford to have access to funding or resources take months*". Based on the analysis of secondary data on E1, it is clear that innovative projects are constantly being started but just as many are being shut down, showcasing the low long-term sustainability of these projects.

6.4 Role of DT in E1

In E1, the role of digital technologies is not clear due to the lack of cohesion and large-scale cross faculty multi-stakeholder innovation projects. However, the living lab actors interviewed

all explained that during the pandemic, they were forced to go fully remote which led to the integration of many digital technologies into their operations. Innovation lab members explain "*When the pandemic hit, we were forced to leave our classroom and go fully online which was a drastic change, but some students actually liked the flexibility offered by being online*". Some of these technologies (video calling (Zoom, Teams, Facetime), document sharing (OneDrive, Email, Confluence) simultaneous collaboration (OneDrive Google Apps), brainstorming tools (Miro, Lucid Charts)) have outlasted the pandemic as they provided easier collaboration and communication methods than traditional physical alternatives. These technologies have a facilitator role in the process of collaboration.

The rise of generative AI was also mentioned by many students partaking in the living lab as they explained that they regularly used it to get explanations on certain subjects or to create ideas as a brainstorming partner. One student of the innovation labs explains "*My project is centred around using AI to help you write for academic purposes*" showing how genAI has already penetrated the classroom for students. The exact role and rules regarding generative AI are still not yet defined in the living lab but the students all use it to varying degrees. This confirms the role that technology can be a facilitator.

6.5 Challenges and Best Practices in E1

As explained above, most of the challenges faced in E1 are due to its very large scale making it hard to be aware of all the actors within it making collaboration and the role of matchmaker difficult if not impossible resulting in the lack of alignment. This large scale also creates a competitive environment in terms of access to resources and funding thus taking away the co-creation aspect required for successful LL initiatives. One faculty member says "*I spend an equal amount of time looking for funding than doing research*" showing how much work is required to get access to the resources of the ecosystem but also how much time could be dedicated towards innovation if access to resources is easier. When it comes to U1, the challenge of the rigidity and siloed structure of the university makes it hard for multi faculty, subject and actor collaboration and once again clashes with the founding principles of LL. Another challenge faced by the actors of U1 is that faculty members who are in the best positions to lead these HEI LL initiatives are often stretched too thin to dedicate their valuable time and energy to projects not backed and recognised by the school which is echoed in the literature (Tercanli et al 2024). A

faculty member echoes this though by saying "*When I teach full time, supervise graduate students and work on my research projects my week is already more than full making it hard for me to try to take part in other projects*".

In terms of best practices, U1 has a lot of motivated and qualified staff and students that are constantly pushing to create new innovation practices to address the challenges of today. Guiding organisations or projects for the essential parts of the entrepreneurial journey are already present within the ecosystem. E1 has a lot of resources and qualified actors they just have not be linked yet. The following two bullet points summarize the challenges and best practices of E1.

- Challenges: The large scale of E1 creates fragmentation, competition for resources, and a lack of alignment among actors, making collaboration and matchmaking difficult. In U1, rigid, siloed university structures and overextended faculty hinder cross-disciplinary initiatives and engagement in Living Lab (LL) projects not officially supported by the institution.
- Best Practices: U1 benefits from highly motivated and capable staff and students driving innovation. E1 contains many resources and qualified actors, and while they remain unconnected, the foundational components for a successful innovation ecosystem are present and can be activated through improved coordination.

6.6 E2 Innovation Ecosystem

Figure 2: E2 Innovation Ecosystem

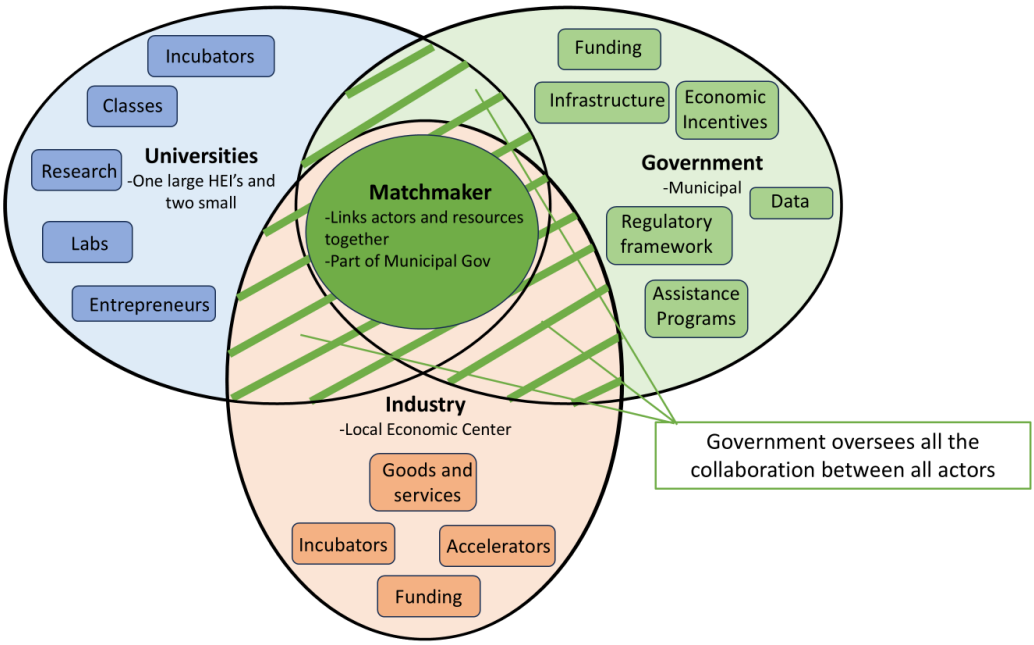


Figure 2 differs from figure one by the presence of a matchmaker at its center. This matchmaker (part of the government) oversees the collaboration between all actors by linking together resources from the different actors.

In E2, there is a more collaborative approach where the government is at the center of the ecosystem as a municipal government branch tasked with fostering and enhancing innovation within the city through innovative strategies and partnerships as represented by the Matchmaker text in Figure 2. Universities, research facilities, entrepreneurs, businesses and incubators all report to the city who has taken on the task of matchmaker as self-described by the head of the city's innovation department when he says, "I match demand to offer thanks to my connections with the different players in our city". As the matchmaker, the city matches entrepreneurs and projects to the right resources that exist within the ecosystem in order to help their ideas grow. This results in the creation of a multi-stakeholder innovation group with the required knowledge needed to guide the entrepreneur towards taking their ideas to the next step. The user, in this case the entrepreneur, which is a member of the community, is helped by diverse stakeholders from his community to come up with solutions or products that will improve his surroundings. The matchmaker has a unique and essential position as they have the relationships and knowledge of

all the actors within the ecosystem, but their only goal and mandate is to put actors together to foster innovation and develop strategies for continuously improving the city's innovation performances. The city and the matchmaker understand that they need to provide the tools and connections to the actors of the ecosystem because they will be able to create more value than the city could on its own, so the city is attempting to set everyone up for success by giving them the best resources and relationships available. The city and its ecosystem have recognized and echoed the idea proposed by multiple authors, which is the importance of multi stakeholder innovation to answer to the challenges imposed on them by today's societal changes.

The city's innovation branch was created less than 10 years ago to respond to a large population increase with a significant portion of this being non-permanent workers from diverse backgrounds and cultures. These people needed jobs, and the city needed to find new ways to fulfill the material and non-material needs of their new citizens. In response, they developed an innovation strategy which started by mapping all the innovation actors within the city. This was done in a collaborative manner with different members of the ecosystem in order to identify all the actors and potential overlaps who could be reduced to increase efficiency within the ecosystem. Once created, emphasis was put on including the citizens in the process by asking them their needs, gathering their ideas through innovation competitions and events and motivating them to partake in the efforts by focusing on improving what they care about and giving them a role to play in the process. Each actor is then used for the unique capabilities it has. The following are some examples of unique capabilities that each actor has in E2:

- U2: large source of educated workforce willing to work (internships, research projects)
- Other universities: thanks to their smaller size, it is able to adapt and make changes to better fit market needs. For example, it was the quickest to implement online learning during Covid.
- Research facilities: have access to unique, specialized and expensive equipment.
- Incubators: Expertise on entrepreneurial journeys and connections within the community.
- Entrepreneurs: possess ideas and visions.

Once these unique resources are pooled together by the matchmaker, entrepreneurs feel empowered and more motivated to push their projects towards completion as explained by the head of the black entrepreneurship program of E2. To really understand what citizens wanted and include them in the innovation efforts, the innovation branch of the city created an effective

idea submission system for citizens. Through this system, citizens could submit their ideas for improving something within their community and they would be listened to and guided towards if there were already existing resources that could help them tackle the issue. This gives multiple purposes and exponential returns to a single resource that might be otherwise unused. For example, a chemistry lab closed outside of teaching hours can be used by an entrepreneurial project by students providing student learning, potential innovation and a more efficient use of university resources. One interviewee summed it up by saying “everyone has something to contribute and trying to combine all that is the key to faster, cheaper and efficient innovation”.

6.7 Role of DT in E2

In E2, technology is an important facilitator to innovation. Throughout the interviews, multiple actors explained how technology has helped entrepreneurs and especially through data analysis and the use of artificial intelligence. The city in E2 has a dedicated data analysis team that uses data to understand its citizens and their living habits better.

Members of the incubator highlighted how generative AI can help entrepreneurs co-create by becoming their “co-founder”. Generative AI has the capability to quickly educate entrepreneurs on basic business practices and can help make operations more efficient by doing part of the work itself. However, it does take time to correctly use generative AI, and entrepreneurs must be taught how to do so in order to reap the full benefits of this technology and that is one of the services offered by the incubator.

In terms of data analysis, the city has used different programs in order to more precisely classify its citizens, their needs and its resources in order to make more effective data driven decisions that more precisely target the desired demographic group. Data has also been gathered by U1 to create a digital twin of the city which is accessible to citizens at the university offering them the capacity to explore the city easily, run simulations or models for different entrepreneurial endeavors.

The universities have also started offering more online classes for jobs in need in order to provide a more flexible education experience for those programs which enables more people to be able to educate themselves and respond to the labor demands of the community.

6.8 Challenges and Best Practices in U2

Throughout the interviews, some reoccurring challenges were identified. Firstly, the bigger the organization (HEI, company, city), the harder it is to collaborate and to make actors work together. Creating smaller interdisciplinary teams or "taskforces" is a more efficient way of collaborating as seen in E2. However, finding the right people to compose these taskforces is difficult.

In terms of technology, there is an issue with people who are new entrepreneurs as they are sometimes scared of technology because they do not understand it. This leads to them avoiding it which means they are missing out on its positive facilitator and accelerator capabilities. There is an opportunity cost dilemma between learning how to use technology or using that time to grow the business using tools and knowledge that the entrepreneur is already familiar with.

HEIs do not collaborate well with each other and there is potential to enhance collaborative innovation efforts in both. Although E2 seems to have a more efficient process than E1, even the head of the innovation department in E2 explains that collaboration between the actors is still far from its full potential and that it is a hard process that constantly needs to be modified and fined tuned requiring flexibility to continuously operate at a high level.

The following two bullet points summarize the best practices and challenges of E2.

- Challenges: Large organizations face difficulties in collaboration due to complexity and scale. Forming effective interdisciplinary taskforces is challenging due to the difficulty in identifying and engaging the right people. New entrepreneurs often avoid using technology out of fear or unfamiliarity, missing out on its benefits. Additionally, HEIs struggle to collaborate effectively with each other, and even in relatively efficient ecosystems like E2, collaboration remains suboptimal and requires ongoing effort and adaptability.
- Best practices: Creating smaller, interdisciplinary taskforces, as seen in E2, is a more effective method of fostering collaboration within large systems. While challenging, continuous refinement and flexible adaptation of collaborative processes can lead to more effective innovation outcomes.

6.9 Cross-Case Analysis

After analyzing these two ecosystems, it is clear to see that they are organized differently, and this is resulting in differing collaborative innovation output performances. However, differences between the two ecosystems exist. By analyzing these two ecosystems and using their strengths and weaknesses along with the comments made by the interviewees, recommendations on how to best integrate LL into HEI in Canada were developed.

E1 is located in a larger city possessing a large innovation ecosystem with other universities, resulting in a competitive landscape for innovation. U1 is also a larger university with a lot of innovative initiatives and motivated students, thus possessing most of the key parts required for an effective academic entrepreneurial ecosystem using LLs but its scale and siloed structure is restricting it from aligning all its innovation activities. Some of the issues U1 is facing align with the most common roadblocks for universities to become innovation hubs which are the following: lack of innovation management, the focus of universities on department centered innovation instead of student-centered innovation and lastly a lack of cooperation with outside ecosystem actors such as municipal governments and private sector.

E2 is much smaller and the number and connections between actors are more evident. Its smaller scale could be the reason for its more collaborative and effective innovative practices as the competition present in E1 might not be in E2. The ecosystem has aligned with a common goal and the actors do not have any competition enabling them to collaborate more easily, but this also gives them a glass ceiling. The actors in the ecosystem right now admit that collaboration can still improve but most of the actors in the ecosystem are already involved, potentially limiting future growth and improvements as no new influx of resources will be added and no competitive pressures push them to strive for better outcomes.

Table 8: Cross Case Analysis Summary

E1	E2
Strengths • Large scale, number of resources, numbers of students and initiatives (multi-method approach)	**Strengths** • High collaboration (multi-stakeholder participation and co-creation)

• U1 has large number of motivated and capable faculty and students (multi-method approach and user involvement) • Large scale (multi-method approach)	• Innovation matchmaking structure (user-involvement and multi-stakeholder participation) • Leveraging DT • Small scale (multi-method approach)
Weakness • Competitive resource allocation (multi-stakeholder participation) • Lack of collaboration between all three actors at once. (multi-stakeholder participation and co-creation)	**Weakness** • Limited resources (multi-method approach)

Table 8 highlights the strengths and weaknesses of both ecosystem while also showing how these strengths and weaknesses can be linked to the LL characteristics in Table 9.In order to further compare the two ecosystems as well as see how they include LL into their operations, we will see how each of the key characteristics of LL proposed by Enoll (user involvement, real-life environment, co-creation, multistakeholder participation and multi-method approach) are applied in table 7.

Table 9: Enoll LL Characteristics in E1 and E2

Characteristic	E1	E2
User Involvement	medium	high
Real-Life Environment	low	medium
Co-Creation	medium	high
Multi-stakeholder Participation	medium	high
Multi-Method Approach	high	medium

This table was filled out following the process highlighted in Table 5 in the methodology section. From this table, it can be seen that E1 benefits from a very large number of methods due to its large size. However, this large size is making the replication of real-life environments more difficult and the participation of multiple stakeholders more difficult, which decreases co-creation potential. E2 benefits from a high level of co-creation due to the different actors of the

ecosystem working together. However, due to its smaller number of actors, there are fewer methodologies being used to solve problems.

Using the analysis of the ecosystems provided in this section which explains the strengths and weaknesses of both ecosystems as well as how they integrate LL practices, the next section provides a way to fill in the identified gaps. By pooling together, the results of the data analysis and taking suggestions made by interviewees on how to improve their ecosystems a model to strengthen academic entrepreneurial ecosystems is developed.

6.10 Strengthening Academic Entrepreneurial Ecosystems

The literature review and the case study have shown that LL can be used in academic entrepreneurial systems by integrating themselves within the greater innovation ecosystem the universities are in. By using the best practices identified in the case studies and suggestions for improving LL practices in academic entrepreneurial ecosystems proposed by the interviewees of this research, a model for improving the integration of LL endeavours into universities is proposed in this section.

Through the analysis of these two ecosystems, we can clearly see that there are strengths and weaknesses in both ecosystems. U1 benefits from many qualified actors and more specifically many students and faculty. The ecosystem also has the resources to take on large and complex projects enabling larger scale with potentially larger impacts. On the other hand, due to the size and current organisation of the ecosystem, collaboration between actors and even within actors is low. U2 benefits from an efficient, productive and established innovation ecosystem centered around the city serving the matchmaking role and providing access to quality data to its entrepreneurs. However, they have reached close to maximum engagement within their ecosystem leading to their progress potentially being capped along with the influx of new resources and new connections between actors.

In response to the weaknesses of the ecosystems highlighted in section 6.9, two potential ideas for increasing collaboration were proposed by the interviewees. By taking these ideas and enriching them with the findings from both the literature and the case study, Figures 3 and 4 were developed. They showcase a way for Canadian HEI to adopt LL methodologies to strengthen their academic entrepreneurial ecosystems. The first solution proposed was the creation of a “Dean of Innovation” within a university. A faculty member explains “*If we could*

have one person that knows all the resources within the whole school and who to contact to connect with them, it would make collaborating with other faculties and schools so much easier" another faculty member goes further by saying "*If we could have a some sort of job board where researchers could ask for specific resources and help for their projects to members of the school, it would make the creation of teams much more efficient*".

Based on the quotes and the best practices identified in the two ecosystem identified in sections 6.4 and 6.7, this person (for single faculties) or team (for whole universities) would identify, coordinate, and unify all the projects being done in the university resulting in a more homogeneous ecosystem within the university which could then go compete as a single entity for the funding offered by the city and provincial government. This is the role matchmakers play in figure 2 which could be replicated in other ecosystems as proposed in figure 3.

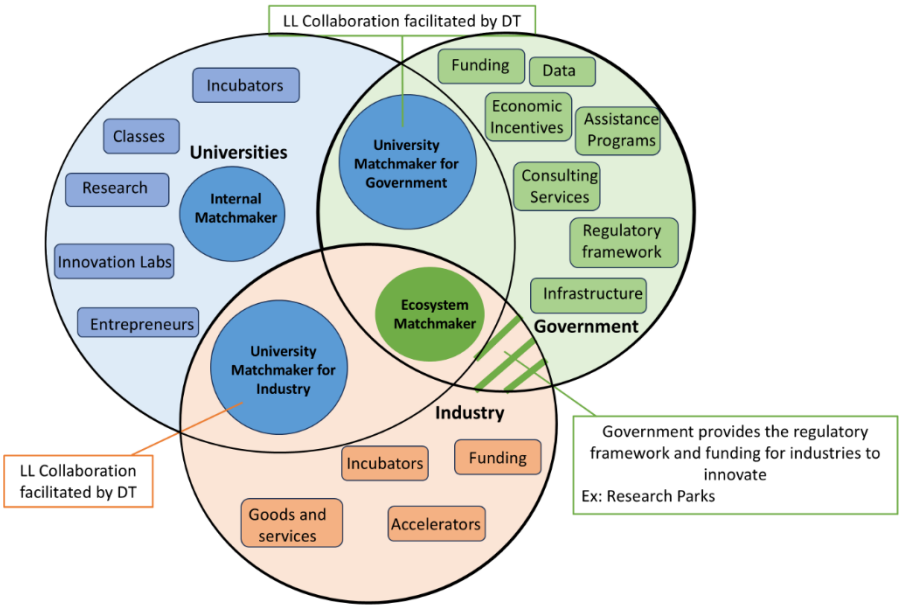
This leads to the second solution identified which is to create an innovation and entrepreneurial journey that would guide ideas and projects towards becoming reality following a LL methodology. A student of the innovation lab of U1 explain "*When I finished the innovation lab, I did not know how and where to take my idea to the next stage*" another says "*I contacted the school's incubator after my time at the innovation lab asking to continue my project and they explained that I would have to start from scratch with them to follow their own internal process*".

These experiences from students show that the academic entrepreneurial journey is far from a straightforward path and there is a lack of continuity and collaboration between the different resources of the academic entrepreneurial ecosystem.

The innovation lab leader at U1 says "*the ideal scenario is that when an idea comes to us it is the first stop in its journey and then it is put on "train tracks" where it takes the required stops it needs*". An example of such journey (as shown in figure 4) could sensitise students and faculty to entrepreneurial journeys via classes, events or workshops followed by an innovation lab to come up with ideas and develop a team for the project which could include actors outside of academia to benefit from the multi-stakeholder approach of LL. Once the idea and project are clearly defined, they could be moved to an accelerator where the first prototypes are made, giving access to incubators where real businesses or brands are created to go to market to industry help or outside investing. The idea is that the university fosters innovation by providing guidance to entrepreneurs and projects along every step of the way. This concept uses the living lab methodology to create a path that guides the academic entrepreneur though the innovation

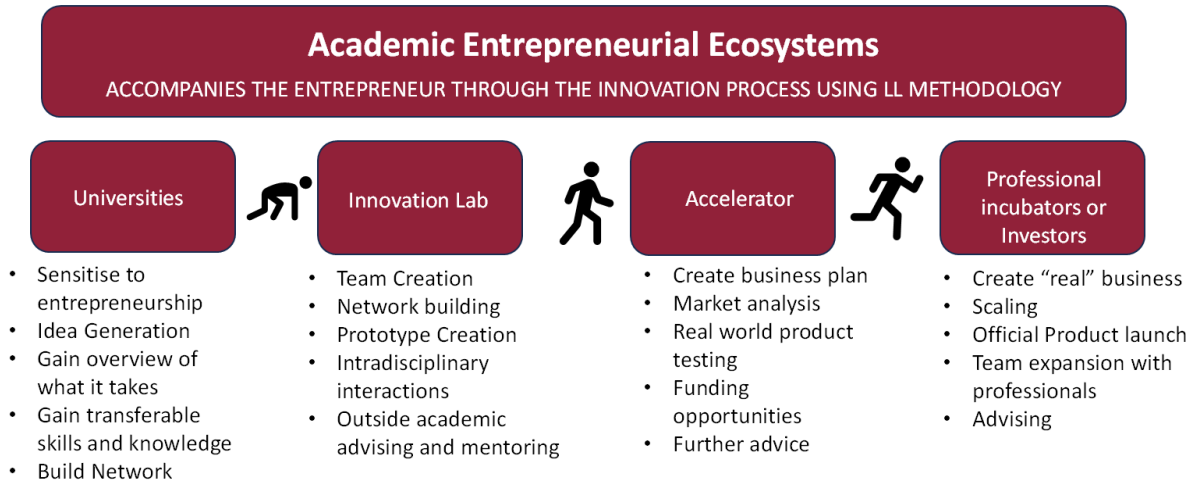
journey by connecting them with different actors that can help the project grow based on their expertise and the current needs of the innovation endeavour. This would empower entrepreneurs within HEI's to team up with members of their innovation ecosystems to co-create value that can directly impact their local communities.

Figure 3: Matchmaker LL Innovation Ecosystem



In this figure, the role of the matchmaker is present for the ecosystem as represented by the green ecosystem matchmaker circle but there are also internal actor matchmakers that serve the same purpose but only for their part of the ecosystem. This could be a way to potentially implement the matchmaking process into larger scale ecosystems as proposed by the interviewees of U1. This also takes the process that is being done at E2 to a deeper level by increasing the amount of matchmaking resources. E2's matchmaker says "*we are now struggling to keep up with all the new entrepreneurs and resources within our ecosystem as they increase faster than we do*", showing the importance of scaling the matchmaking power with the number of resources and size of the ecosystem in order for the process to be done effectively.

Figure 4: Strengthening Academic Entrepreneurial Ecosystems



Bringing this matchmaking LL methodology to the academic level, Figure 4 represents a way to link together common actors of academic innovation ecosystems in order to provide entrepreneurs with path that has the right resources and knowledge to take them through their full entrepreneurial journey. This model is developed by taking into consideration data from the interviews as well as the strengths and weaknesses identified during the case study. This model accounts for the difficulty of creating a streamlined innovation path inside of academic entrepreneurial ecosystems by creating a straightforward path that guides the entrepreneur through his journey. This path enables the entrepreneur to come into contact with actors from different backgrounds thanks to the connections made between them using the matchmaking role as proposed in this research.

These academic entrepreneurial ecosystems would be governed in the first two steps by a "dean of innovation" or "HEI Matchmaker" who could serve the role of the matchmaker. Due to the large scale of E1, it would be possible to have such a network within each large university of the ecosystem which could working with industry and government actors outside of academia. To bring this methodology to E1 however, the team would need to be much larger than the one seen in E2 due to the larger scale of E1.

For U1 and E1 to experience the same results as U2 and E2, collaboration needs to be heavily increased. This can be done in three ways based on the interviews conducted: (1) taking down the innovation silos within U1, (2) creating an "innovation manager" that oversees the innovation activities in U1 and nurture the relationships between its actors, (3) take advantage of E1's

vibrant and many innovation resources. E1 has the highest student per capita in North America and is one of the most productive city in Canada for innovation (Dunham, 2017). This means the resources and actors are present in E1 but not linked and this could be due to the competitive aspect of the ecosystem. With the three steps proposed above, U1 could have an effective internal innovation network that could push projects from infancy to a more "business ready" level effectively thanks to the effective use of the resources and energy of the actors within U1. When it comes to E1 as a whole, it is hard to exactly replicate what is being done in E2 but ideas can be applied and modified to fit the larger scale.

By applying the model explained in figure 3, Canadian universities could be better equipped to face the challenges the post pandemic digital age has brought. This answers the research question of this paper by providing a way to strengthen academic entrepreneurial ecosystem

7. DISCUSSION

In this section, the results from the case study are compared to what was proposed in the literature review of van den Heuvel et al (2021) along with the other papers analyzed in the literature review section of this research. This analysis focuses on the four areas of interest drawn from the coding process which are post pandemic changes, role of DT, new HEI mission transition and challenges and best practices. Additionally, the role of managers is looked at as it was identified as a key success factor in the literature review. Finally, the research question was circled back to in order to see how this research has answered it.

The literature showcases Covid as a catalyst for the adoption of HEI living labs because the role of HEI was put into questions as society faced more challenges. These forces outside of the control of universities pushed them to adopt a more agile and less hierarchical structure producing research that can directly impact their community (Urmanaviciene et al, 2022). The case study identified that U1 did not get the catalytic effect to break down siloes. However, the amount of innovation and the push for more interactive learning approaches can be seen in the increase in innovation initiatives being created in the university. On the other hand, E2 was already ahead before the pandemic but the pandemic reinvigorated and justified the solutions being undertaken by the ecosystem actors. This showcases a discrepancy between the literature and what we observe in practice as the catalytic effect of the pandemic identified in the literature

is only half reflected in practice as HEI structures did not change but the push for more innovation initiatives happened.

The pandemic was also a push for digital technologies to become more widespread in academia. The increase in the use of digital technologies in academia spread to LL and it was done in the same way as DT serve the role of collaboration and communication facilitators in LL (Maria Fernandes-Jesus et al, 2024). However, the literature explains that digital technologies can take on a larger role by becoming competitive advantages if integrated correctly into the innovation ecosystem or if entrepreneurs are correctly trained to use the technology, enabling it to take on the role of any other tool and become a source of competitive advantage for the entrepreneur.

For the next topic of interest, the literature (van Engelenhoven (2023), Urmanaviciene et al (2022) Konstantinidis et al (2021), van den Heuvel et al (2021)) as well as the case studies show that LL are a fitting solution to respond to the inclusion of a new mission into universities. LL provide a unique innovation approach that brings together users to the centre of the innovation process along with multiple stakeholders resulting in innovation that has a direct impact on its users and is capable of doing so thanks to the direct implication and collaboration with multiple actors outside of academia as seen in both ecosystems and as mentioned in Figure 3. This user and community centred approach offers HEI with the ability to achieve the goal of the new mission which is to have direct societal impact.

Another aspect that is highlighted by both the literature (Davidson et al, (2022) and Chapagain and Mikkelsen (2023)) and the case study is the fact that LL provide students with more applicable professional skills and teach them how to become productive members of society better than regular classes can, further helping universities to have direct societal impact by creating future qualified individuals. Through LL labs, students get the opportunity to deepen their understanding of skills and concepts by directly applying them in professional settings. Exposure to working professionals from outside academia also enables them to benefit from a more diverse source of knowledge and learn the soft skills that will help them navigate the professional world.

Lastly, in terms of challenges and best practices, the literature highlights the importance of qualified, flexible, communicative and adaptive leadership that leads to effective collaboration and communication between diverse stakeholders (Tercanli, 2024). The case study echoes that and also adds on that the set up and backing of the lab by HEIs is essential for long-term success

of HEI LL and that is something that HEI still need to improve on in order to reap the full benefits of HEI LL as seen in the first ecosystem. In the second ecosystem, the role of a matchmaker is an essential component of their innovation strategy leading to an efficient and productive innovation ecosystem within a city. Overall, this research's analysis answers the research question by explaining that the digital age has brought on changes to HEI, resulting in them needing to change to continue contributing to society. This change is focused on giving a greater impact to academic research to positively impact society and this can be done successfully through living labs which has been shown in the literature and in practice. Through the implementation of LL within communities and the adoption of the LL methodology, innovation ecosystems can create tracks where entrepreneurs can benefit from the help of different actors at different stages of their journey to co-create value.

Thanks to the analysis of pre and post pandemic literature findings supplemented by case analysis findings, this research has answered how has the Canadian Living Lab (LL) landscape evolved in the context of Higher Education Institutions (HEIs) in the digital age.

The Canadian Living Lab landscape within Higher Education Institutions has evolved significantly in the digital age, though not uniformly. The COVID-19 pandemic acted as a partial catalyst, pushing HEIs to adopt more innovative and interactive approaches to learning and research, though deeply embedded institutional siloes often limited structural transformation. While digital technologies have become more prevalent and serve as collaboration tools within LLs, their full potential as strategic assets remains underutilized, particularly when entrepreneurs lack the training to integrate them effectively.

The evolution of LLs is also closely tied to the HEIs' transition toward embracing a "new mission" generating direct societal impact. LLs have emerged as effective mechanisms for this by enabling user-centered, multi-stakeholder collaboration that addresses real-world problems. They also provide students with hands-on, professionally relevant experiences that enhance employability and civic engagement.

However, persistent challenges such as lack of inter-HEI collaboration, limited institutional support, and difficulty in sustaining cross-sector partnerships still hinder the full realization of LL benefits. The presence of skilled and adaptive leadership, as well as institutional backing and the strategic use of matchmakers, are key best practices identified for success.

In summary, the digital age has pushed HEIs in Canada to evolve through LLs, offering a promising model for societal engagement and innovation, although structural and strategic improvements are still needed to unlock their full potential.

8. IMPLICATIONS

8.1 Theoretical Implications

For theoretical implications, the updated literature provides insights on some of the changes the pandemic has brought on to HEI LL but there is still a lack of research on this subject which may be due to the pandemic's recency and the fact that HEI LL are a budding subject themselves. The updated literature review also highlights the current state of the literature on the role of DT within HEI LL, the ability of LL to fulfil the new mission of HEIs and provides a new concept of best practices which is the matchmaker role.

The empirical findings from this study help bring more clarity on the effect of the pandemic, the role of DT, challenges and best practices in HEI led LL and the fulfilment of the HEI new mission in real life case in the Canadian LL landscape.

8.2 Practical Implications

In practice, there seems to be clear benefits to using LL as a means to answer the challenges that universities are facing in today's digital age, thus answering my research question.

HEI's can use LL to fulfil their new mission thanks to their unique characteristics. However, most HEIs are not fully ready to adopt these practices as they are structurally and organizationally opposite to the siloed hierarchical nature of HEI. In order to facilitate their adoption, HEI need to believe in the idea and its benefits to provide resources to motivate its employees to take part in LL initiatives. Once the university has committed to LL initiatives, a a matchmaker role is a good way to connect the initiatives and actors together which is essential to successful LL practices. A matchmaker can be included in large HEI who can support multiple diverse endeavours but can also be present on a government level to be the bridge between academia, business and government, thus fully unlocking the benefits of multi-stakeholder innovation offered by LL.

For industry, the implications are centered around the definitions and characteristics of the actors within the projects. Within LL, the roles of every actor need to be clearly defined from the start

to ensure smooth collaboration. The role of the LL manager is essential, and they must have an adaptive, collaborative and dynamic management style to accommodate for the unpredictable and dynamic nature of LL and the differences in knowledge, communication styles and backgrounds of the different actors. To render communication and collaboration easier, digital technologies can be used as a facilitator enabling more direct real time communication and collaboration. In more established LL, more complex digital technologies can enable better decision-making, more efficient processes or even more creativeness as long as the actors of the labs or entrepreneurs are ready and correctly trained to use these technologies. LL offer industry with a new way to innovate with the actors of their ecosystem, creating and strengthening partnerships and collaboration. Businesses will also benefit from the same economic activity but will also get continued access to top talent thanks to universities across the country maintaining their status as some of the best in the world. Additionally, they will also get candidates that have had diverse experiences with people from diverse backgrounds from which they learned, developed their soft skills and acquired professionally transferable skills. This unique combination of skills gives them a stronger base to succeed in the workplace than if they did not partake in any LL endeavours. This approach also enables industry to not have to carry the burden of creating innovative solutions by themselves, further making the innovation process easier and more enticing. Overall, this research should encourage practitioners to set up LL but explains that the set-up is essential to the success of the initiatives.

The best practices and challenges identified in this research could be applied to similar situations across the world. Canadian universities are facing multiple challenges but many other developed countries with high-ranking universities are also facing some of these challenges. The rise of generative AI decreased student enrolment, and different types of regulatory pressures can be seen in countries with similar economic and social development levels. The solution provided by LL to this problem could then be applied globally in order to protect universities across the world facing the same challenges.

Lastly, as LL enable entire ecosystems to co-create value, municipal governments will reap the benefits from their efforts to set up LL innovation ecosystem. The government will see their universities maintain their world class status and produce top talent while their economy is spurred on by benefiting from the innovation its actors are creating together.

8.3 Limitations and Future Research

The first limitations of this study are the recurring ones for case studies which are the highly contextualized nature of the findings and problems relating to replicability which I attempted to address through our reliability testing (Recker, 2021). Secondly, this research only focused on Canada so an analysis of other countries would give more insights and potentially confirm the conclusion drawn in this paper. A deeper look at technology might enable a more precise understanding of the role of technology as our research focused on many subjects resulting in a potential loss of granularity that could uncover more subject specific information.

Another limitation for this research is linked to the scope of the case study which is looking at the two ecosystems as a whole. This was done due to the fact that the living lab initiatives and other innovation practices observed during the case study do not evolve in isolation as they are all part of the overarching ecosystem. This has made this research have a very broad scope, resulting in the opportunity for further research to be done with narrower scopes to have a more precise and less broad view of the ecosystem.

In terms of future research, multiple avenues could be explored in order to expand this subject. Firstly, more research on the difference between large- and small-scale academic innovation networks needs to be done in order to identify more best practices and see if some of the differences identified in performance are due to scale or not. Following this thread, the integration of the matchmaking structure into large scale ecosystem needs to be done. This can help develop a road map to the integration of the matchmaker structure into large scale innovation ecosystem and see if it can be successful in these larger ecosystems. In order to dive deeper into this idea, DT could have the potential to facilitate the integration of the matchmaker into innovation ecosystems. Through the creation of digital platforms, knowledge suppliers and demanders can be matched together to render the matchmaking process easier and more efficient for both parties (Chang et al, 2019). The creation of digital matchmaking platforms could provide an effective way to conduct the ecosystem matchmaking role presented in ecosystem two. This could also be a way to scale the matchmaking process to larger scale ecosystems. This would fit into the current role of DT as collaboration facilitator, but it would be a much more important contributor to the ease of collaboration and LL set up process. Further research on this idea could help shed more light on how to fully leverage DT to maximize their facilitator role.

The difference between collaboration initiatives in resources competitive ecosystems and non-resource competitive ecosystem could explain some of the difference in innovation performances identified in this research. Another research avenue would be to look at more effects of the pandemic as its effects continue to be studied. A deeper look into the role of ecosystem matchmakers and managers could lead to a better understandings of HEI LL functioning and the prerequisites to their success. As the amount of case studies increases, quantitative studies could be used to confirm the following qualitative hypotheses for small and large ecosystems.

- Small ecosystem: can a single matchmaking team oversee an entire ecosystem or does the creation of internal actor (industry, government and HEI) lead to better collaboration following LL principles?
- Large Ecosystem: does breaking down structural siloes within HEI help HEIs increase collaboration internally in order to better compete in their resource competitive innovation ecosystem?

In terms of literature, there is still a lack of literature on the role of DT in HEI LL and although the research on best practices in HEI LL has improved, no clear structure or set-up instructions for successful HEI LL exist. More research will need to be done to correctly define and compare all the different initiatives being executed worldwide. I mention worldwide because I believe that by showing that LL can be a solution to the problems facing Canadian universities, the HEI LL can be tested and applied in other countries with similar situations to Canada's in order to decrease the pressures facing universities

9. CONCLUSION

This research clearly shows that LL is a unique way to address the unique situation that is facing HEI as they tackle the new challenges posed by our modern society in the digital age. Due to the unique characteristics of LL proposed by Enoll (user involvement, real-life environment, co-creation, multistakeholder participation and multi-method approach) they offer solutions that can give a direct societal impact to academic research thus fulfilling the new mission of universities enabling them to stay relevant in today's modern digital society where information is available at the tap of a finger or the prompt in a genAI model. LL are also a way to teach more transferable professional skills and can be a complement to traditional HEI educational practices to give students a better tool set to start their professional journey. LL can also serve as a way to

increase student involvement and collaboration, which has been lost in part due to the pandemic. This offers universities with a tap into their largest idea generating source which is its large dynamic, progressive and innovative student bodies.

This is also a means to ensure universities continue to bring benefits to society thanks to the use of collaboration with new actors that are already present in their ecosystem. This can help universities produce academic innovation by discovering new solutions, ideas, prototypes that can push their rankings up without having to expend massive amounts of capital or having to attract as many graduate students as possible to produce quality research. This unique combination of opportunities offered by the adoption of LL by HEI can be a solution to the situation facing Canadian universities as they face a reduction in funding, and student numbers, regulatory pressures and a more digital less interactive learning experience due to the changes brough on by the pandemic. LL offer an alternative way of doing research that doesn't require much funding and international graduate students but only to become aware of all the different actors in an HEI's innovation ecosystem to start collaborating with them.

This collaboration offers many benefits but as mentioned in this study, reaping those benefits takes time, HEI organizational changes, mindset changes and a good set-up, practices and management to ensure successful LL outputs.

10. ANNEXES

ANNEX 1: LITERATURE REVIEW METHODOLOGY

Methodology

The research done by van de Heuvel et al (2021) was used as the basis for the literature review. When searching for work that had been done on LL within an HEI framework, not many results came up as this is a budding topic. The most recent and comprehensive work found was a scoping literature review done by van den Heuvel, Braun, de Bruin and Daniëls in 2021. Their work serves as the basis for the methodology of this research's literature review. Van den Heuvel et al conducted a scoping literature review to determine how HEIs shape and manage the LLs they lead. A scoping literature review is an adequate research method as it goes beyond single case studies of specific LL which are very frequent in this field but do not provide an overarching understanding and analysis of LL (Schuurman and Tõnurist, 2016). Van de Heuvel et al based their work on the five-stage approach of Arksey and O'Malley (2005). The same process and keyword search string as Van de Heuvel et al for AB/TI in Ebsco was followed to retrieve papers. The keywords search string were as follows:

1. Learning environment OR education environment OR education OR student involvement AND
2. Living lab OR living labs OR living laboratory OR living laboratories

This search string encompasses the two aspects of interest which are education and living labs. In the work done by van de Heuvel et al, 427 papers came up from which 21 were selected after screening for title followed by abstract and full text.

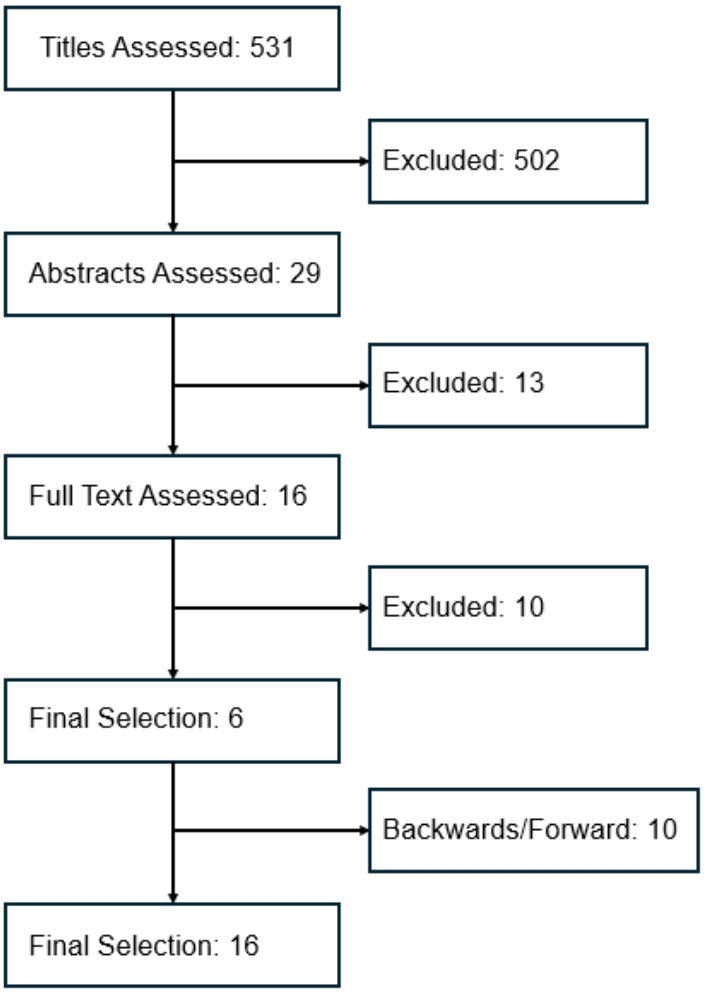
To expand on the study previously mentioned, this research provides an update as well as an analysis of the changes in LL following the pandemic. The previous research collected papers and articles between 2000 and June 2021. This research looked at the timeframe of 2021 to 2024 as it is of interest as it includes the pandemic and post pandemic period during which the role of digital technologies in universities increased as well as the popularity of living labs. A search of "living labs" on google scholar between the two timeframes of 2000-2021 and 2021-2024 yields 17 800 and 19 500 results respectively showing an increase in research being conducted on LL. An initial search using the same search string on EbscoHost searching in all databases and filtering for only English papers published from 2021 to 2025 landed 531 hits. The papers were based on the criteria in the following table.

Table 10: Literature Review Exclusion/Inclusion Criteria

Criteria	Inclusion	Exclusion
Field of Research	Is in the business or education field	Is not in the business field
Title contents	Includes living labs or a derivative and a mention of education (school, universities, academia, classes, research, HEI, learning environment, academic institutions)	Does not include LL or a mention of education
Abstract and introduction content	Research is focused on Research LL and not Urban LL or Testbeds	Research is not focused on research LL
Full text screening	Analyze if the living lab studied has a link to an HEI. OR Describes collaboration between universities and non-academic actors.	Collaboration studied has no link to education.

From there, the titles were screened to see if they mentioned living lab (or one of its derivatives) and universities (or other related content such as education environment, academic, classes, learning environment, HEI, institutions). With this screening, 502 papers were dropped leaving 29 papers for the abstract assessment. When looking at the abstract, I determined if the subject of the paper was relevant to the research. This led to 13 more papers being dropped, leaving 16 papers left for full text screening. The full text screening was performed to see if the whole paper included material that would be relevant for answering the research questions. This final screening led to a rejection of 10 more papers for a final selection of 6.

Figure 5: Prisma Diagram



The last step in the literature review process was to perform a backwards and forwards selection on the final 6 papers (Webster and Watson, 2002). This led to the inclusion of another 10 papers in the final pool used for the literature review in this section. Most of the papers pulled from the forward and backward search were papers that are some of the most well known in the subject of living labs and were referenced in a majority of the papers screened. These papers serve as some of the theoretical foundations and building blocks of living lab research and have already been cited previously in this research.

Overall, this led to a total of 16 papers included in the literature review, which is five less than what was included in the paper by van de Heuvel et al (2021). This final selection (Annex 2) was used to answer our research question using a specific set of codes in order to classify the areas of research and perform data reduction.

Following an initial review of the literature, the research question and common themes found in HEI LL research, four codes were developed to analyze the data.

As this updated literature review looks at the post pandemic period, it was essential to see what the literature identified as the effects of the pandemic on the subject which was the first criterion. Related to the pandemic was the role of DT as it drastically increased inside of academia during the pandemic and it is important to see of these changes were reflected in LL endeavors, resulting in the second criteria. The third criterion which looks at the potential of LL to fulfill the HEI new mission was essential to answering the problem facing academia as explained in the introduction section. Lastly, identifying challenges and best practices is essential to this research as it can help create a methodology on how to correctly and effectively set up HEI LL and what common challenges to avoid.

The finalized criteria list is as follows:

- Pandemic Period Changes
- Role of DT
- HEI New Mission Transition
- Challenges and Best Practices

These criteria were used in the literature review as well as the case study to create a common thread providing continuity and consistency throughout the different research steps.

In order to classify the data into the right criterion, a deductive coding approach was implemented to assign one or multiple codes to relevant data. This enabled a first data reduction as any redundant or irrelevant information was not attributed to a code. Below are two examples of the coding method used for the literature review.

- Davidson et al, 2022 page 37: “We created documentation using the collaborative, online knowledge management software Notion, supplemented with diagrams in Miro, and the primary means of communication used the messaging platform Discord. These tools permitted the flexibility to update the documentation rapidly, both by staff and students, and effortlessly invite collaboration from extra-academic actors, which would otherwise have been challenging with the university’s sanctioned communication technology and learning management software.”

  This excerpt was given the code: Role of DT.

- Tercanli et al, 2024, page 2: “Researchers are increasingly expected to deliver socially robust knowledge to address today's global challenges (Schot & Steinmueller, 2016) while considering the needs of diverse stakeholders (Wehrens et al., 2014). This calls for new forms of research, often of a transdisciplinary nature (Polk, 2015) and involving a larger variety of actors and research environments (Kuhlmann & Rip, 2019). In response to these needs, living labs have emerged as an interface—a physical, or sometimes a virtual space—where researchers from higher education institutions (HEIs) collaborate with companies, citizens, non-profit organisations and government institutes in projects focusing on a variety of issues around sustainable development (Trencher et al., 2014).” This excerpt was given the code: HEI new mission transition.

This coding process was applied for all 17 papers of the literature review and a summary of the coding process is provided in Table 2. Once every paper was analyzed and its relevant information classified into the right criteria, each criteria’s set of information was subsequently summarized in order to come up with an overall understanding of what the literature said for each criterion. These summaries are explained in section four. These summaries were created through thematic grouping which enabled the last round of data reduction, giving a concise understanding of the literature on the subject.

To ensure the validity of this coding process, a peer review was conducted. A graduate research assistant was given at random five papers from the literature review final selection to analyse following the coding process outlined in the previous paragraph. This resulted in a 92% similarity score with the coding done in this research, ensuring the accuracy of the literature review data analysis process of this research.

ANNEX 2: LITERATURE REVIEW FINAL SELECTION

1. Almirall, E., M. Lee, & Wareham, J. (2012). Mapping living labs in the landscape of innovation methodologies. Technology Innovation Management Review, September 2012, 12–18.

2. Almirall, E., & Wareham, J. (2011). Living Labs: arbiters of mid-and ground-level innovation. Technology Analysis & Strategic Management, 23(1), 87-102

3. Ballon, P., & Schuurman, D. (2015). Living labs: concepts, tools and cases. info, 17(4).

4. Bergvall-Kåreborn B., Ståhlbröst A. (2009). Living lab: An open and citizen-centric approach for innovation. International Journal of Innovation and Regional Development, 1(4), 356–370. https://doi.org/10.1504/IJIRD.2009.022727

5. Chapagain, M. R., & Mikkelsen, B. E. (2023). Is a Living Lab Also a Learning Lab?—Exploring Co-Creational Power of Young People in a Local Community Food Context. Youth (2673-995X), 3(2), 753–776. https://doi-org.lib-ezproxy.concordia.ca/10.3390/youth3020049

6. Davidson, A.-L., Harlap, A., & Bhuiyan, N. (2022). A Living Lab Approach to Prepare Students to Be Confident Innovators. Interventions Économiques, 68, 31–50.

7. Hossain M., Leminen S., Westerlund M. (2019). A systematic review of living lab literature. Journal of Cleaner Production, 213, 976–988.

8. Konstantinidis, E. I., Petsani, D., & Bamidis, P. D. (2021). Teaching university students co-creation and living lab methodologies through experiential learning activities and preparing them for RRI. Health Informatics Journal, 27(1), 1–12. https://doi-org.lib-ezproxy.concordia.ca/10.1177/1460458221991204

9. Leminen, S., Westerlund, M., & Nyström, A.-G. (2012). Living Labs as open-innovation networks. Technology Innovation Management Review, 2(9), 6–11

10. Maria Fernandes-Jesus, Lorna Hamilton, Catherine Heinemeyer, & Jude Parks. (2024). Qualitative Research Methods in the Living Lab: Reflecting upon a Learning and Teaching Approach for Promoting Psychological Literacy. Psychology Learning and Teaching, 23(2), 235–247. https://doi-org.lib-ezproxy.concordia.ca/10.1177/14757257231221005

11. Schuurman, D., De Marez, L., & Ballon, P. (2013). Open innovation processes in living lab innovation systems: Insights from the LeYLab. Technology Innovation Management Review, 3(11).

12. Schuurman, D., & Tõnurist, P. (2016). Innovation in the public sector: Exploring the characteristics and potential of living labs and innovation labs. In OpenLivingLab Days 2016 (pp. 78-90).

13. Tercanli, H., Jongbloed, B., & Meulen, B. (2024). Strategic boundary management in university-based living labs. Higher Education Quarterly, 1. https://doi-org.lib-ezproxy.concordia.ca/10.1111/hequ.12558

14. Tercanli, H., Jongbloed, B., & van der Meulen, B. (2024). Exploring prescriptive and agile management of university-based living labs. European Journal of Higher Education, 14(sup1), 29–49.

15. Urmanaviciene, A., Kostalova, J., Baturina, D., Krzyworzeka, P., Budrytė, P., & Lepik, K. L. (2022). Were Social Labs immune to COVID-19? Impacts and benefits. Management & Marketing, 17(s1), 381-401.

16. van Engelenhoven, A. M., Geiger, J. L., Ünal, A. B., Spinder, R.-N., & van der Zande, I. S. E. (2023). Student perceptions of Living Lab research internships in the COVID-19 pandemic – a Dutch case study. Education + Training, 65(10), 65–80. https://doi-org.lib-ezproxy.concordia.ca/10.1108/ET-06-2022-0236

ANNEX 3: LITERATURE REVIEW PAPER ANALYSIS

van den Heuvel et al (2021) Analysis

Definition

In this paper, the definition of living labs used is the one proposed by Enoll. The authors highlight five important aspects of Living-Labs: real-life setting, co-creation, active user involvement, multi-stakeholder participation, and a multi-method approach. In the papers analyzed by the authors, the definitions generally align with the one proposed by Enoll although some do make a specific mention of integrating education and research into the definition which can be explained by the fact that I am looking for LL related to HEI.

Role of DT

Technology is present in LL as a facilitator of collaboration. LL use digital platforms and tools to engage their actors and in HEI more specifically, students. DT can serve as a means of effective communication and knowledge management. However, there is still no set specific role for DT in LL especially due to the wide range of different topics that can be studied through LL.

New HEI Mission Transition

The authors explain that LL are innovative ways to prepare students for the professional world by teaching more relevant and workplace transferable skills than regular classes thanks to their hands-on experience with interdisciplinary actors. Through living-labs, students can connect with professionals from a wide range of fields and take on part of their knowledge and skills. There is still a lack of consensus on how to best integrate LL into HEI and the authors call for more research to be done on this topic.

Challenges and Best Practices

The best practices identified by the authors are first and foremost the emphasis of collaboration and co-creation that enables diverse stakeholders to work together on projects. In order for this to happen, a good management structure needs to be put in place in order to manage and nurture the relationships between actors who have different skill sets, knowledge levels and communication

styles. A flat and flexible leadership seems to be the best solution in order to break down the common hierarchical structure of workplaces.

In terms of challenges, the opposition of the flexible, unpredictable and exploratory nature of LL clashes with the traditional structured, planned and timed approach of traditional HEI learning. This usually puts strain on the managers and the longevity and sustainability of HEI LL projects as ensuring their financial stability requires astute planning and dynamic management.

Table 11: Summary of van den Heuvel Analysis

Definition	Enoll
Role of DT	Collaboration facilitator but still no commonly agreed upon set role.
New HEI Mission Transition	LL provide students with more professionally transferable learning outcomes
Challenges and Best Practices	Best practices: co-creation approach, flat leadership. Challenges: Flexibility vs Rigidity, financial

Updated Literature Review Analysis

Definitions

When looking at the proposed definitions of LL, 5 papers reference Bergvall-Kåreborn and Ståhlbröst (2009) and Almiral and Wareham (2011). Bergvall-Kåreborn and Ståhlbröst use the definition proposed by Enoll as I did previously in this paper. Almiral and Wareham explain in their definition that LL are user centered and that the labs are set in real world settings. Their definition also explains that LL can refer to either the methodology or the "instrument or agency" associated with the project. The papers that propose definitions that are different are all from after 2021 and use more complex and in-depth definitions of LL for their research, showing the progress that was made in the LL field post pandemic. As more research was done in the field, a more complete and complex understanding of LL was introduced leading to definitions becoming more precise and not as general as the ones proposed before the 2021 period. However, two papers from after 2021 still use Bergvall-Kåreborn and Ståhlbröst (2009) or Almiral and Wareham (2011) as their basic definitions but then add on more elements to complete their definition. Konstantinidis et al (2021) adds that living labs can be virtual or

physical spaces to provide solutions for challenges relating to technology, society or services, thus highlighting the versatility of the methodology in terms of application and set-up. Chapagain and Mikkelsen (2023), Van Engelenhoven (2023) and Konstantinidis et al (2021) add elements to highlight the ability for LL to bring together academia and outside actors in order to give more meaning and applicable outcomes to academic research. These additions add to the research and help define the subject but there still does not seem to be a clear standard definition. Overall, the five elements of the Enoll definition Iuse (user involvement, real-life environment, co-creation, multistakeholder participation, and multi-method approach) were represented in the definitions of all the papers analysed in different ways and explained in different words but the core ideals were present in all the definitions.

Pandemic Period Changes

Looking at changes brought on to HEI LL after the 2021 time period, only three papers addressed this issue. Firstly, Davidson et al (2022) explained that due to the pandemic, the living lab analyzed had to switch to virtual delivery which led to the use of new tools such as Miro, Zoom or Discord to brainstorm, meet and chat instead of classic physical alternatives. Maria Fernandes-Jesus (2024) also explains that due to the pandemic, new online tools were used to communicate but there was an emphasis put on getting students to work in person after the pandemic in order to recreate bonds and communications channels that are essential to collaboration. This idea is echoed by van Engelenhoven (2023) who states that during the pandemic, a lot of work had to be done to establish clear communications channels because in their absence, there was little to no information sharing between LL actors. Users partaking in the lab stated that online delivery transformed the lab into a less engaging and fun experience and reduced motivation. Most interestingly, Urmanaviciene et al, 2022 explain how the COVID-19 pandemic forced HEI to do something they were not used to doing previously which is to rapidly change and adapt. When combined with the fact that deviating away from siloed structures for bureaucratic process is a preliminary condition for social innovation, the pandemic was the perfect catalyst for the change towards HEI adopting LL as potential research methodologies (Urmanaviciene et al, 2022). This might be the most important part of this section because the pandemic did force HEI to change rapidly and showed them the importance of having a greater social contribution as they saw the world around them shutting down. This

increased impulse to create innovation was also reported by the living labs actors studied by Urmanaviciene et al (2022), as they state “The pandemia gave an impulse to develop innovations, be involved in new research areas, find new partners, and increase digitalisation processes. As a result, most investigated labs switched to the new working model. They implemented new activities to strengthen their communities and maintain readiness to continue their mission after the crisis”. This highlights the fact that the pandemic was a catalyst towards LL adoption by HEI and was a testament to their potential if done successfully as the study states that out of the 21 labs studied, one didn’t outlast the pandemic but the remaining 20 all came out stronger and more ready to deal with the increasing uncertainty our modern world is facing. On top of that, it pushed actors in and out of academia to look for new innovation partners which led to the creation of new partnerships which is essential to the co-creation process used in LL.

Role of DT

When looking at the role of DT, Davidson et al (2022) and Maria Fernandes-Jesus et al (2024) were the only papers in which the role of digital technologies in LL was mentioned. They both state that during the pandemic, digital technologies were facilitators for communications as they replaced traditional in person communication channels. These new communication channels became better than in-person channels as they enabled instant communication and collaboration on projects. Davidson et al, (2022) also states that the using these more informal and digital communication channels rendered it easier to reach out and communicate with partners outside of academia thanks to the alleviated burden of university sanctioned communication channels. However, beyond these two points, no other mention of the role of DT was made confirming the lack of research on the subject (Urbinati et al, 2020).

HEI New Mission Transition

All the papers published after 2021 highlight the potential for LL to address the new “social impact” mission of HEI. Firstly, Urmanaviciene et al (2022) explain that active engagement of HEI’s in social innovation leads to them creating knowledge sharing and collaborative platforms or places in order to bring together diverse stakeholder groups. This thought is shared with Konstantinidis et al (2021). This facilitates the collaboration of society with HEI and more accurately responds to the needs of ecosystem actors by applying knowledge directly to their

needs. Davidson et al (2022) and Chapagain and Mikkelsen (2023) state that LL that engage students with industry actors and related projects lead to students developing better workplace transferable skills such as taking initiatives, critical thinking, networking etc. Van Engelenhoven (2023) adds that while soft skills are developed, hard skills were actually the ones who improved the most in the experience they looked at meaning that students partaking in LL improve their soft skills thanks to the new situations they are put in but also their hard skills by applying them outside of academic settings. The authors also state that universities must adapt and start teaching students how to develop their soft skills more than their hard skills as this makes them more prepared for the workplace which will make them better industry actors positively impacting their community and thus fulfilling the third mission of universities. Tercanli et al (2024) confirms our theory that LL are an adequate way of addressing the changes facing universities both in the evolving role in society and to correctly respond to the global challenges they face thanks to their collaborative approach. Van Engelenhoven (2023) states "LLs are not only beneficial for stakeholders and society as they generate new insights into societal questions, they are also of added value to students who actively collaborate with the external organizations and researchers. The LLs can thus be seen as a method of education which contributes to students' preparation for future careers, which is one of the main tasks of higher education institutions". This excerpt combines and echoes the ideas from Davidson et al (2022) and Tercanli et al (2024) as the author also explains that in response to todays challenges, quadruple helix collaboration is essential due to the complexity of the problems requiring diverse expertise to solve.

Challenges and Best Practices

In terms of best practices, most papers have insights on the subject, starting with Tercanli et al (2024) who share insights on boundary management in LL. They explain that project management in LL is difficult due to the flexible nature of the labs who have different types of projects and the diversity of stakeholders with differing motivations, motives and goals. In order to resolve that, boundary work is essential, and they explain that lab managers should be encouraged to make setting a common vision their number one priority. Prior to this though, the matching of stakeholders with the right projects and LL is essential for success in these endeavors. LL use management principles of adaptability, openness and ongoing collaboration

which differ from standard industry practices of linear progress management. This requires adaptation on the part of stakeholders and lab managers and some sort of "education" on the subject should be given to actors before the innovation projects are undertaken in order to create a more fertile ground for success. These program managers should adopt a participatory approach where they expect everyone to participate what they can in unequal amount. This ensures flexibility and continued motivation on the actor's part but renders the innovation process slower than if managers adopted a more standard linear progress approach. The position of project manager for these LL is not an easy one as it requires specific skills such as management skills, innovation knowledge and patience and Tercanli et al (2024) write that in HEI, in order to motivate employees to take on the role of managers, clear long term salaried contracts should be given out in order to comply with the uncertainty of the length of projects that tends to push educators away from these projects. This enables managers to proactively and dynamically change their management approaches and project timelines with the security of employment and funding. Maria Fernandes-Jesus et al (2024) expands on this by further emphasizing that lab managers should have strong communication skills and domain expertise in order to be able to bridge the knowledge gaps between actors, especially if students are involved. To better address this issue, they recommend bringing in cross faculty teams to LL projects in order to have better coverage of all the subjects that could potentially be brought up during the innovation process. The authors also argue that incorporating students in the projects leads to better student engagement but also satisfaction meaning that HEI LL are an adequate approach to answering student needs. Another point made by Chapagain and Mikkelsen (2023) and Davidson et al (2022) ties into this as they explain that when working with students and industry professionals, clear roles should be given to everyone in order to facilitate collaboration and knowledge transfers leading to more successful LL. Overall, all the authors highlight the importance of being flexible in LL projects and the key role that the managers play in the success of the LL.

Table 12: Summary of Literature Review Papers

Definitions	The 5 elements of the Enoll definition are present in all definitions and they become more precise as the recency of the paper increases.

Post Pandemic Changes	Increase in the prevalence of DT and a push for newer more innovative pedagogies to motivate students. The pandemic was a catalyst for the adoption of LL.
Role of DT	Communication and Collaboration facilitator.
New HEI Mission Transition	LL are an adequate way to address complex societal challenges by providing unique outcomes that can fulfill the third mission of HEI.
Challenges and Best Practices	Best practices: Flexible Management, Managerial Financial Compensation, Cross Faculty leadership and clear role definition Challenges: Flexibility vs Rigidity, Role of Managers, Stakeholder team composition, Financial Stability and Adequate Student Engagement.

ANNEX 4: SAMPLE INTERVIEW QUESTIONNAIRE

Segment 1: Used to gain insights on what INITIATIVE A does and what the role INTERVIEWEE is in the initiative.

- Briefly describe what initiative A is, its history and structure.
- Within this structure, what is your role?
- What does initiative A do? You outline opportunities offered by the initiative on your website. Are these correct or do you offer different things?
- What learning outcomes can a student expect from participating in initiative A?

Segment 2: Understanding how the activities are run and who is involved.

- How do you create and run activities in initiative A?
    - Who do you involve (members of the innovation ecosystem, outside partners, students, professors)?
    - What is a timeline you use?
    - What are the resources initiative A provides?
- How are you initiative managers chosen and what do you look for in them?

Segment 3: Methodology and research philosophy.

- What makes initiative A different from other initiatives?
- Your website states that creativity, participatory knowledge building, and meaningful partnerships, are some elements that generate the best ideas that lead to meaningful and impactful innovation. How do you incorporate these aspects into your activities?
- Why do you think it is important to include students as leaders and practitioners in the process?
- How is the university included in initiative A?
- How do you make sure there is a good collaboration and information sharing between your different participants?
- Do digital technologies play a role in how initiative A is run?
- How are digital technologies used by the actors of initiative A?

Segment 4: Pandemic changes

- Was initiative A underway before and after covid?
    - If so, what are some of the chances that were brough on by the pandemic?
    - Has technology taken a larger role in your activities since the pandemic?
- If initiative A was not underway before the pandemic, was it a result or response to some problems seen by the pandemic?
    - Was the pandemic and the changes it brought a motivating factor to start initiative A.

Segment 5: Business and Performance

- What are the goals of initiative A?
- Who funds the initiative?
    - What are the benefits or downsides of being linked to the university if that is the case?
- How do you measure the success of the initiative and is performance an important driver of the initiative ?
- Are you facing any challenges with the initiative or with how the activities are run?

Segment 6: Final thoughts

- Is there anything else you would like to add to this conversation?

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