



Research-In-Progress Paper

Living Lab approaches in the energy transition and decarbonization context: overcoming barriers and seizing opportunities for sustainable innovation in the construction sector

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Abstract

In the context of the energy transition and industry decarbonization, the construction field has a big part to play. With over one third of global greenhouse gas emissions, it is urgent that this sector gets its current practices to evolve. Facing increasingly complex problems related to changing norms and regulations, material shortage, massive renovation needs, slow innovation integration and a very vast panel of stakeholders, the building sector needs methods and tools to manage and overcome these challenges. Living Lab approaches can be very effective at tackling such “wicked problems”, but are currently underused in this specific field. The aim of this research is to find the barriers that hinder the use of these techniques, and which are the opportunities to be seized. Based on literature and field research (both on the academic and partner sides), a tailored support tool will be developed to help researchers successfully run projects using Living Lab methods and tools. This project aims to foster the use of Living Lab approaches and help reach greater sustainability and relevance of future projects in the built environment, all while guaranteeing a good life quality for the inhabitants.

Key words

Living Lab approaches, Construction sector, Multidisciplinary collaboration, Energy transition, Decarbonization



Introduction

In the context of the energy transition, academics, cities, and public administrations seem to have a growing interest in Living Labs. They have been popping up all over the world since the early 2000's with a noticeable increase taking place after 2015 [Schuurman & Leminen, 2021]. Despite their popularity, Living Labs face a number of challenges and their impact is still difficult to evaluate. Most of the existing assessment methods and frameworks focus on the functioning of the Living Lab itself and not on its wider impact [Bouwma et al., 2022]. As relevant research is currently done on the impact evaluation side, this paper aims to focus on the barriers and opportunities encountered by Living Lab approaches in the construction sector [Molinari et al., 2023]. With 37% of the global greenhouse gas emissions [United Nations Environment Programme, 2023] this specific field is a key player in the energy transition. The construction sector has its own specificities and constraints. It is strongly regulated by norms and standards, the acceptance and generalisation of innovation tend to be slow, it is a very cost driven and liberal market and is home to a large diversity of stakeholders. To significantly contribute to the Sustainable Development Goals in the fields of “Industry, innovation and infrastructures,” “Sustainable cities and communities” but also “Good health and well-being” and “Affordable and clean energy” among others, the building actors must collaborate more effectively [Femenias & Hagbert, 2013]. Living Lab methodologies and tools can be very effective to address such “wicked problems” but are currently under exploited in this area [Malakhatka et al. 2021]. This research's goal is to assess the readiness of the construction field and the barriers and opportunities to be seized for the integration and use of Living Lab approaches. The level of awareness and skills of the scientists running Living Labs or projects using Living Lab approaches will also be studied. Recommendations and support tools or systems will be developed and tested.

Context

Located in Switzerland, the Smart Living Lab (SLL) is a research and development centre for the future of the built environment aiming to achieve energy efficiency, digital transformation, and well-being for its occupants. Interdisciplinary research projects are pursued with experiments carried out in real-life conditions. The SLL brings together the combined expertise of the Swiss Federal Institute of Technology Lausanne (EPFL), the School of Engineering and Architecture of Fribourg (HEIA-FR), and the University of Fribourg (UNIFR). The SLL has been housed on the Bluefactory site in Fribourg since 2014.





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Starting construction in 2025, the future SLL building will not only house SLL staff, but it will also fully serve as a research infrastructure. Flexible, adaptable, and always at the cutting edge of innovation, it will be used to carry out experiments under real-life conditions. The building is an example of collaborative design in defiance of current standards and blockages with the aim of achieving the 2050 neutral carbon targets. The support process, as well as the future exploitation are run by an interdisciplinary group called BUILD with a hybrid mission set between research and operational practice.

Within the framework of the SWICE research project (Sustainable Well-being for the Individual and the Collectivity in the Energy transition) funded by the Swiss Federal Office for Energy (SFOE), researchers as well as economic and institutional actors teamed up with the SLL to join forces and advance current practices in the world of building and urban planning. In parallel to fundamental research being carried in SWICE, pilot and demonstration projects are particularly interesting for the application of the Living Lab approaches including co-creation involving multiple stakeholders (quadruple-helix concept) [Kristiaan et al. 2023].

In the SLL context, researchers regularly lead complex projects with multiple stakeholders including other academic institutions, start-ups and private companies, energy suppliers, professional associations, cities, and public administrations as well as citizens (Figure 1). The projects run over several years, which increases the challenge of keeping everyone involved as well as maintaining a tangible common goal. The construction sector is particularly prone to 'lock-in' with many strong barriers hindering the market uptake of sustainable innovations [Andersson & Rahe, 2017]. Researchers often face a certain inertia and lack of risk taking in this field and end users are rarely or only punctually integrated in the processes, which creates gaps between what is built and what is needed.



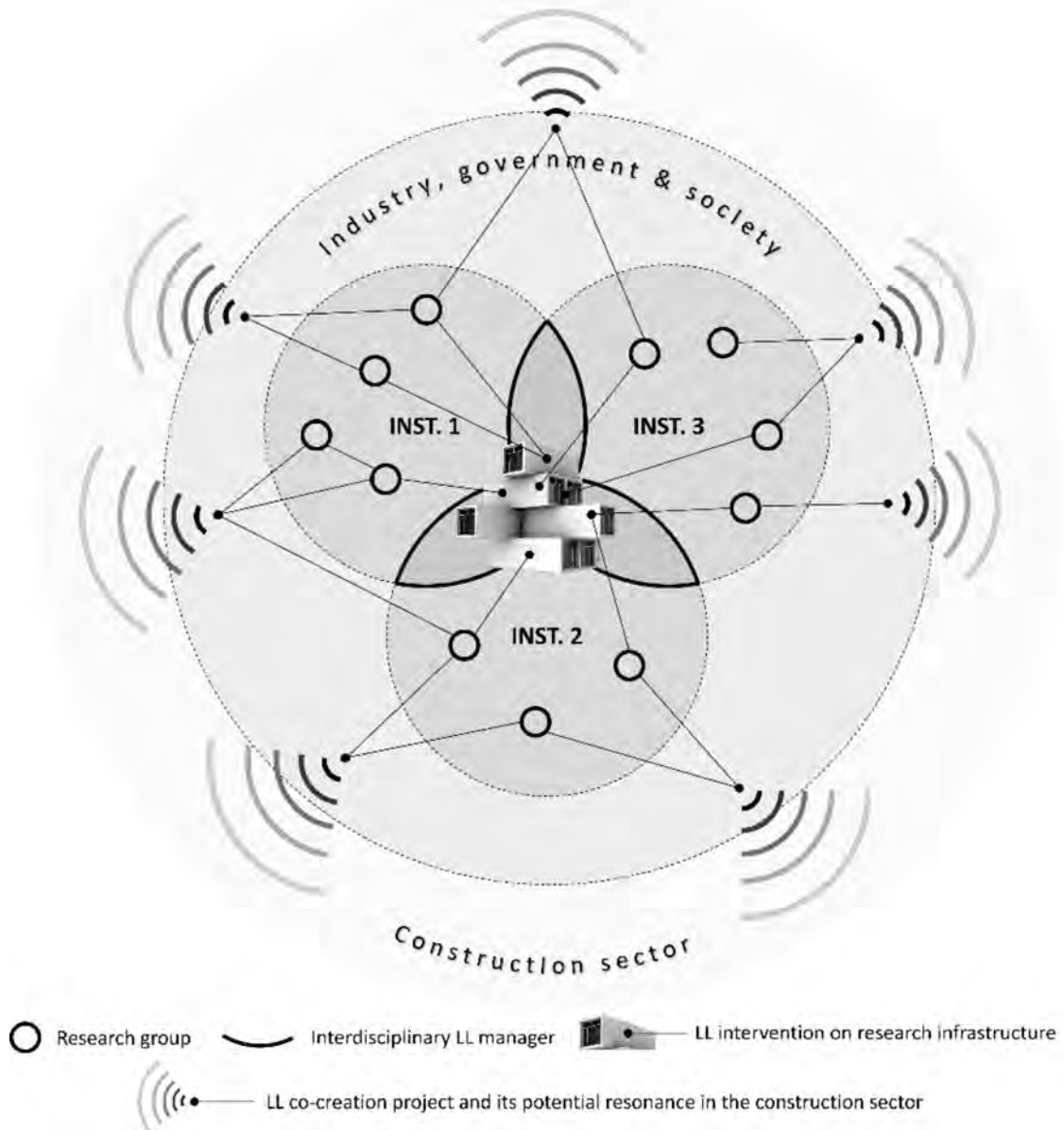


Figure 1. Schematic representation of the organization surrounding the Smart Living Lab's intervention, illustrating the multiple objectives and research groups involved. The diagram highlights the interfaces between various activities and the resonance, or technology transfer, to the construction sector.

Methodology

Two research questions were defined for this work:

- What are the socio-cultural aspects and specificities of the construction sector that constitute opportunities or obstacles for the use of Living Lab methodologies in the context of a transition towards sustainability?
- What are the needs of the different actors for a successful use and implementation of these methods and tools in their projects?



To answer these questions, a literature review and in-depth field research are being conducted. Using a design thinking approach, researchers of the SLL, mostly professors and PhD candidates of the HEIA-FR, were interviewed during the Spring 2024 to define their level of confidence and expertise regarding Living Lab approaches. Collected qualitative data includes auto evaluation of scientists' maturity regarding Living Lab methodologies, the frequency and type of projects in which these methods are used, the challenges and opportunities encountered, as well as the needed support to use these techniques more effectively in the research projects.

External partners and stakeholders, either recommended by researchers or part of the SLL ecosystem, are being interviewed in the second phase of this research that runs from June to August 2024. The aim of these interviews is to gather information about the readiness of the building sector to embrace Living Lab approaches, define the barriers and opportunities seen by the actors of the sector and evaluate how to increase awareness and leverage their capacity to integrate these approaches.

1st findings and next steps

During the first series of bilateral interviews a considerably uneven level of knowledge and awareness about Living Lab approaches can be noticed. Some researchers, mostly active in the mobility and urbanism fields, have a marked user centered and in real life approach, but rarely apply co-creation in their practice. Others, mostly engineers (civil, IT and mechanical) but also architects, are less familiar with the Living Lab concepts. A keen interest is shown towards the effective management of a wide range of stakeholders. The question of a greater impact and a better acceptance of the final solution is also regularly put on the forefront. On the other hand, elements like replicability, knowledge transfer, stakeholder selection, data management, communication and legal aspects are mentioned as challenges. Very few researchers seem to notice that even though lots of stakeholders are involved in their projects, co-creation is often missing. Even the most experimented scientists admit their lack of practical tools when it comes to creating and running co-creation workshops. Managing expectations and conflicts or information retention during workshops also tend to worry. Furthermore, it was mentioned that co-creation could put the research question and mission in peril. Users or other stakeholders might make the project evolve in a direction not the one intended by the researchers, challenging the project in terms of purpose, content, schedule, or financing. The projects run at the SLL are generally initiated by researchers, based on their knowledge of the field and informal exchanges with partners. It is rare that an in-depth need analysis is carried out in the field before defining project objectives and deliverables. This tends to bias the co-creation phase. Another element that can lead to a bias during the project is the



researcher's double role. They tend to be both field experts and Living Lab managers, which can become difficult in certain situations.

During the Summer 2024, further interviews will be conducted with construction companies, investment funds, public administrations, and municipalities as well as professional association representatives to have a full picture of the barriers and opportunities faced by the construction sector when tackling sustainability questions while considering the use of Living Lab methods.

After completing the literature review and interviews, an environmental analysis will be conducted. This will highlight the areas of development with a strong potential and where Living Lab methods are most suitable and impactful. This will lead to the development of a 'support prototype' during the Fall 2024. The main goal of this prototype is to assist the researchers in effectively implementing Living Lab methodologies in their projects. This will add value, increase their research's effect, and generate more benefits for society. The prototype will be tested through iteration and regular feedback collected to reach an effective tool useful in practice. Depending on the needs gathered during the interviews, this prototype may take the form of an introduction workshop, recommendations, a coaching program, and/or a toolbox.

Conclusion

This research aims to determine how ready the construction sector is to embrace Living Lab approaches. Are these methods relevant in this context? Who are the key players who can insufflate such ideas? How can researchers or Living Lab managers trigger them? What do researchers need to be more confident in leading Living Labs? Those are the questions answered in the following steps of this research.

By focusing on a very specific market segment; the regional construction and real estate ecosystem in the energy transition context, this research activates an entire network. Interviewing a multitude of stakeholders, meeting them in their reality is already acting on the system and accelerating the intake of innovation.

Although some biases are to be taken into consideration, like the interviewee selection, which are for most part members of the SLL network, this research also opens new potential research questions. Who are the key actors in the construction sector who can make the change happen and reach the energy transition objectives? How do the governance and validation processes influence the end results in this specific area? How great is the distance between society, power, and money?





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Once the external stakeholders interviewed and their interest and influence mapped out, recommendations will be emitted on where Living Lab methods are most valuable and appropriate.

It is essential to define who in the construction field has the highest interest in using Living Lab approaches and for which reasons. Only then will it be clear how to activate and work with them. Understanding the benefits seen through the eyes of these key stakeholders will define the type of implication but also the support needed by the researchers.

By trying to understand both sides: the specificities of the construction field as well as the needs of the researchers, this project aims to better define the opportunities for the use of Living Lab approaches in the decarbonization context and help reach a greater sustainability and relevance of future projects in the build environment.



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