DEPARTMENT OF INTERNATIONAL AND EUROPEAN ECONOMIC STUDIES

ATHENS UNIVERSITY OF ECONOMICS AND BUSINESS

The Living Lab Modeler. A tool to leverage the activities and impact of your Living Lab

Panagiota Koltsida

Eleni Toli

Christos Marinos-Kouris

Michail Dorgiakis

Yannis Ioannidis

Phoebe Koundouri

Working Paper Series

24-11

May 2024

The Living Lab Modeler
A tool to leverage the activities and impact of your Living Lab

Authors

Panagiota Koltsida*, Eleni Toli*, Christos Marinos-Kouris*, Michail Dorgiakis*, Yannis Ioannidis**, Phoebe Koundouri ***
*Athena Research and Innovation Center, GR
**Athena Research and Innovation Center, GR, National and Kapodistrian University of Athens, Department of Informatics, GR
*** Athens University of Economics and Business, School of Economics and ReSEES Laboratory, GR, Technical University of Denmark, Department of Technology, Management and Economics, DK, Athena Research and Innovation Center, GR

The Living Lab Modeler

Abstract

The Living Lab Modeler (LLM) is a web-based application that enables the digital representation of Living Labs (LLs) and the facilitation of their activities.
LLM is designed on the premise of LLs being user-centred innovation ecosystems that rely on multi-stakeholder collaboration to drive innovation. The LLM addresses commonly observed shortcomings in the operation of Living Labs, by providing a digital solution to support core LL activities such as stakeholder management, activity tracking, outcome documentation, and reporting, including also more specialised modules that depict the interactions among the LL's 'ecosystem' entities. The first version of LLM was developed as part of the DESIRA H2020 project and tested with European LLs that sprang on the premise of DESIRA.
This paper presents the empirical observations along with Living Lab related theoretical and conceptual perspectives that contributed to the shaping of the LLM, subsequently developing on the main design principles and functionalities, providing a comprehensive outline of the multifaceted capabilities of the tool and showcasing its potential.

Key words

Living Lab operation, Living Lab management, digital tools and solutions, user-centred innovation ecosystems, co-creation methodologies

Subtitle

A tool to leverage the activities and impact of your Living Lab

1. Introduction: Living Labs as user-centred ecosystems

The Living Labs (LLs) have become over the years a widely used approach and method for recording problems and developing solutions. Living Lab practitioners and theorists have attempted to classify Living Labs into various categories [Dutilleul et al., 2010, Ballon et al., 2018, ENoLL Catalogue 2023]. The differences in categorising the LLs stem from the distinct theoretical and conceptual angles that researchers and practitioners approach the LL methodology. There is also a broad diversity in terms of themes and application domains, in attempts to frame and further define the field.

Despite these differences between the various approaches, that are put forward as inherent in the concept, there is a common understanding that LLs are defined by active user involvement in the innovation process and employ a user-centred and design-driven methodology, often involving co-creation, real-life experimentation, and even prototyping. They have been largely used to co-design and foster tailored innovation outcomes that meet community needs, increase decision-making, enhance inclusivity, and facilitate knowledge transfer and capacity building [Niitamo et al., 2006]. Moreover, Living Labs are deployed to embed results in given contexts, and to further translate and scale up shared knowledge and collaboratively produced outcomes [Leminen et al.,2012].

Because Living Labs are user-centred ecosystems, they heavily rely on the active engagement and collaboration of various stakeholders to drive innovation. The multi-stakeholder engagement perquisite enables the cross-pollination of ideas, the sharing of resources and knowledge, and the alignment of varying interests across the participating actors. This collaborative approach is a fundamental block of the Living Lab methodology that enables LLs to address challenges that involve complex interactions among its constituting entities, towards a common goal [Schuurman et al 2016].

The structure of Living Labs also dictates the interplay of involved actors, which has shown a significant impact on the type of innovation outcomes they can achieve. Distributed structures can support multiple connections and interactions among a variety of actors, promoting radical

innovation potential, while more centralized structures tend to foster incremental innovation outcomes [Deward & Dutton, 1986].

From another innovation theory perspective, Living Labs toggle between Open innovation schemes and user-centred innovation. LL's can adopt characteristics and deploy activities that are both focused on sharing between/among the Living Lab stakeholders, and/or go beyond the Living Lab's boundaries for new knowledge. In essence an LL can strive for the exploitation of internal (inside-out) and external (outside-in) pathways for Innovation [Gassmann & Enkel, 2004].

To reap the best of both worlds in terms of structure (distributed/centralised) and innovation pathways (open/ user generated) Living Labs should operate with a distributed system of innovation within a group of individuals and/or organizations that are centred on a unifying infrastructure. This way, the endeavour of innovation is no longer in the firm or left in the open but resides in the managed and supported LL participating community [Sawhney & Prandelli, 2000].

2. Untapped potential, despite increased presence of LLs

Over the past decades Living Labs have grown and evolved from a social experiment level into a proven and widely used innovation inducement concept that is supported by solid methodological guidelines for enabling bottom-up participatory design for innovative outcomes [Schuurman, 2015]. The ENoLL's public activity reports provide an indication on the upward trend of the usage of the LL methodology globally. Based on ENoLL's cited data the trajectory of Living Labs (LLs) usage has exhibited notable developments over the years. In 2014, the European Network of Living Labs (ENoLL) comprised 25 members with 340 accredited living labs. Subsequent years witnessed a substantial increase, with the number of living labs reaching 450 by 2019 and further rising to 469 in 2020. The progression continued in 2022, with ENoLL boasting 151 active members spanning 35 countries across 5 continents, a trend that persisted in 2023 with 155 active members in 37 countries [Ståhlbröst, 2013, ENoLL Activity Reports 2014-2022]. A similar trend is observed also in the area of the European Commission funded projects: only in the H2020 and Horizon Europe frameworks, there are more than 3.000 funded projects that implement Living Lab activities.

Undoubtedly, by deploying flexibility over the inertia of closed systems architecture, or bypassing the traditional risk averse R&D strategies dictated by the thorough exploration of market competencies, the open and user-centred LL innovation approach provides significant benefits to overcome societal or market barriers [Das et al., 2018]. Still, Living Labs face fundamental barriers that hinder the potential impact of innovation in their ecosystems. The maintenance of processes and operation, as well as the active stakeholder engagement in co-creation processes remains a challenging task. Valuable ideas and innovation potential that is created through the Living Labs

is difficult to be harvested, does not survive the ending of the labs, is not exploited and, thus, is not "translated" into services and tools for the wellbeing of societies.

Based on a combination of scientific literature and our working experience of setting up and operating LLs, we concluded in the following points perceived as LL recurring barriers, which played a catalytic role for the actualisation of our own LL supporting digital solution.

Supporting the LL fundament

LLs often lack clear focus and fail to establish spearheads to declare a distinguishable profile. Moreover, Living Labs could benefit from a supporting tool that allows a clear governance structure, strategic planning and clear KPI setting. LLs could greatly benefit from an infrastructural LL environment to 'host' innovation and innovators.

Sustaining LL lifecycle and ensuring impact

Living labs are often set up on a project basis that also dictates their lifecycle. As a result, the built-up knowledge and expertise relies on the projects planning on efficient exploitation of results and planning of resources to ensure sustainability. For sustaining and exploiting results, LLs should move to a non-project centralised resource, providing repository services that help store, archive and retain, the created knowledge, and sustaining the LL network of stakeholders, ensuring the long-term exploitation and use of results [Schuurman et al. 2016].

Evaluation & Assessment of outcomes

Building on the previous point, LLs also lack clear monitoring mechanisms to measure their impact and allow the evaluation of their outcomes or their mother-projects outcomes, past the funding period of these projects. LLs need a causal link between actions or decisions and effects, a causal link between various iterations of multi-stakeholder inputs and functional outputs, outcomes and impacts [Ballon et al., 2018].

Scaling of impact

LLs often fail to externalise their actions and outcomes. This insular state hurts their visibility and impedes the extension of the Living Lab beyond its 'physical' boundaries directly tied with its core actors/actions. Limited visibility induces difficulties in allowing seamless stakeholder participation that in turn may also bring skewed inclusion methods during the co-creation process. LLs switchover to inward-looking systems restrain liaison opportunities and limit the scaling of their results and their potential impacts.

The above commonly encountered problems, also observed from our own personal experiences in Living Lab practice, and the empirical knowledge shared from various researchers and practitioners, have motivated us to design and develop a dedicated tool, that would address these shortcomings. Additionally, we in our work we came across with ambiguity in relation to the 'interpretation' of "What can be considered a Living Lab? Which are the critical factors that define it? Are there any encompassing rules that should apply across Living Labs? How can we facilitate the Living Lab's governance and administration?"

Our attempt to address all these issues, has been the driving force behind the Living Lab Modeler development.

3. The Living Lab Modeler (LLM) solution

3.1 LLM approach and general idea

The Living Lab Modeler is a web-based application that enables the digital re-creation of a Living Lab and facilitates and supports its activities in multifaceted ways.

The main premises of LLM stem from our perspectives on issues that hinder innovation processes and try to provide solutions through theory and practice-based design.

The Living Lab Modeler a) emphasises the importance of accurate and transparent reporting mechanisms within a LL, b) establishes a link between actions or decisions and effects, as well as facilitates iterations of multi-stakeholder inputs and functional outputs, c) operationalises innovation processes by providing capacities to deal with knowledge exploration, retention and exploitation, d) provides increased degrees of freedom for the Living Lab's stakeholders / LL modelers end-users to self-define their roles and function both as, observers, respondents, or be involved on equal footing as co-creators in the innovation processes.

3.2 Overall design principles

The LLM solution is designed to address the gaps and shortcomings identified in the operation and realisation of Living Labs. Its objective is to improve and facilitate the engagement of participants, as well as the dissemination and uptake of outcomes and conclusions. The LLM concept and functionality are based on the idea of supporting LL activities during the lifetime of the Living Labs and beyond their operation. It serves as an online tool that assists LL organizers and participants, as well as external users interested in the work produced by each LL.

The main design principles of LLM aim to create a framework that can accommodate and digitally represent any Living Lab, regardless of its application domain or offline methodology. This is achieved through the adoption of a generic LL methodology. The design of LLM also includes a set of functional modules, which can be mandatory or optional. These modules encapsulate the available functionality and enable the selection and instantiation of a subset of modules for each LL, based on its modelling and representational needs. This modular design makes the application extensible and simplifies the implementation of new functional modules at a later stage.

Finally, LLM utilises an abstract model for modelling the core entities of a Living Lab. This model allows LL facilitators to define custom attributes for each entity and add their distinguished entities, providing them with the freedom to customise their Living Lab and retrieve custom analytics.

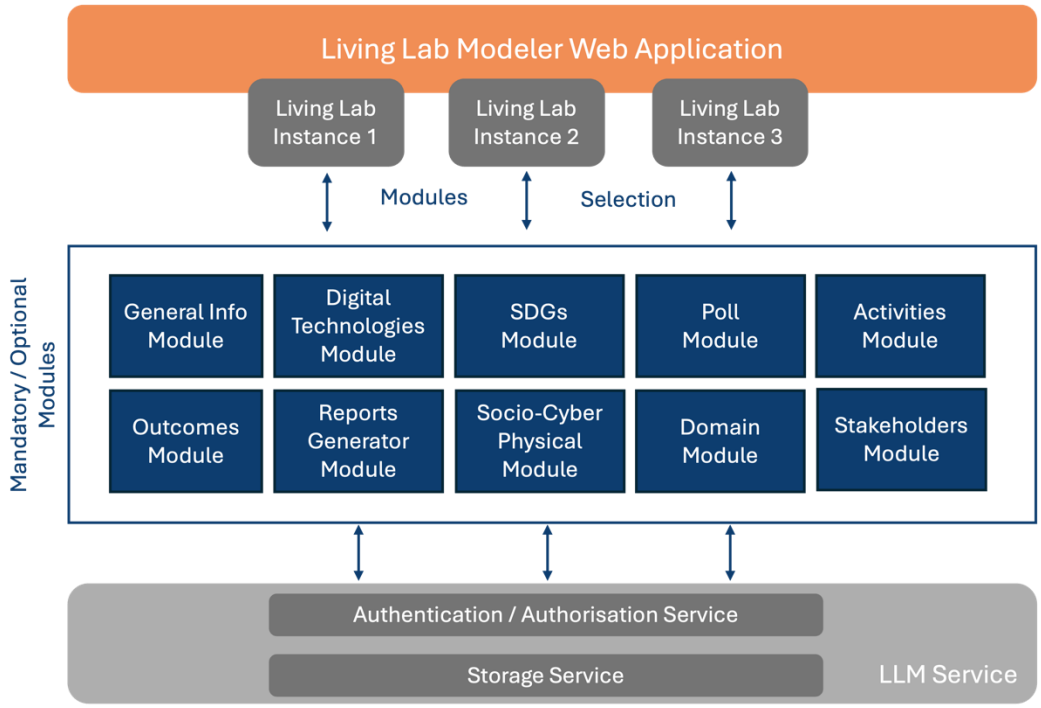

Figure 1: Living Lab Modeler Concept Diagram

3.3 LLM Architecture Design

LLM consists of a Web Application and a Back End Service; the Web Application depicts all views and information of the system where the Back End Service manages all related system information. Through the Web Application, LLM allows the LL creator to enable or disable the supported modules that are attached to each LL and encapsulate different pieces of functionality in the LLM service side depending on his/her needs.

3.4 The Web Application

LLM allows the modelling of Living Labs through a Web Application. The application is available for both guest and authenticated users. Guest users can view the information for all public LLs, while authenticated users can ask to become members of a LL, access restricted information and, based on their role, edit the LLs they are managing. Figure 2 presents a sample of the application pages of existing Living Labs.

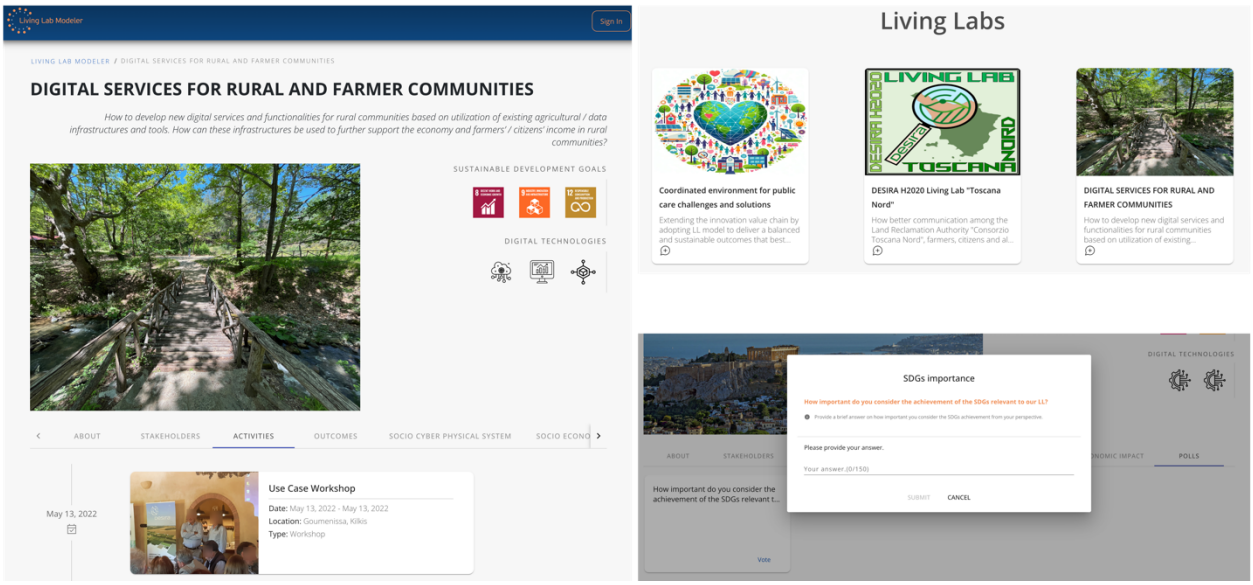

Figure 2: Living Lab Modeler - Sample views

The process of creating a LL through our application is designed to be straightforward and user-friendly. Authenticated users can easily create, organise, and update their own LL. It all begins with selecting and enabling the functional modules that best suit the LL's needs. From there, the user simply fills in the required information. The different modules can be completed in real-time as the LL activities unfold, or they can be based on the specific needs for actions that the application facilitates. The LL organiser has full control over the visibility of the LL, whether to make it public and accessible to a wider audience, or to keep it private and available to its members only.

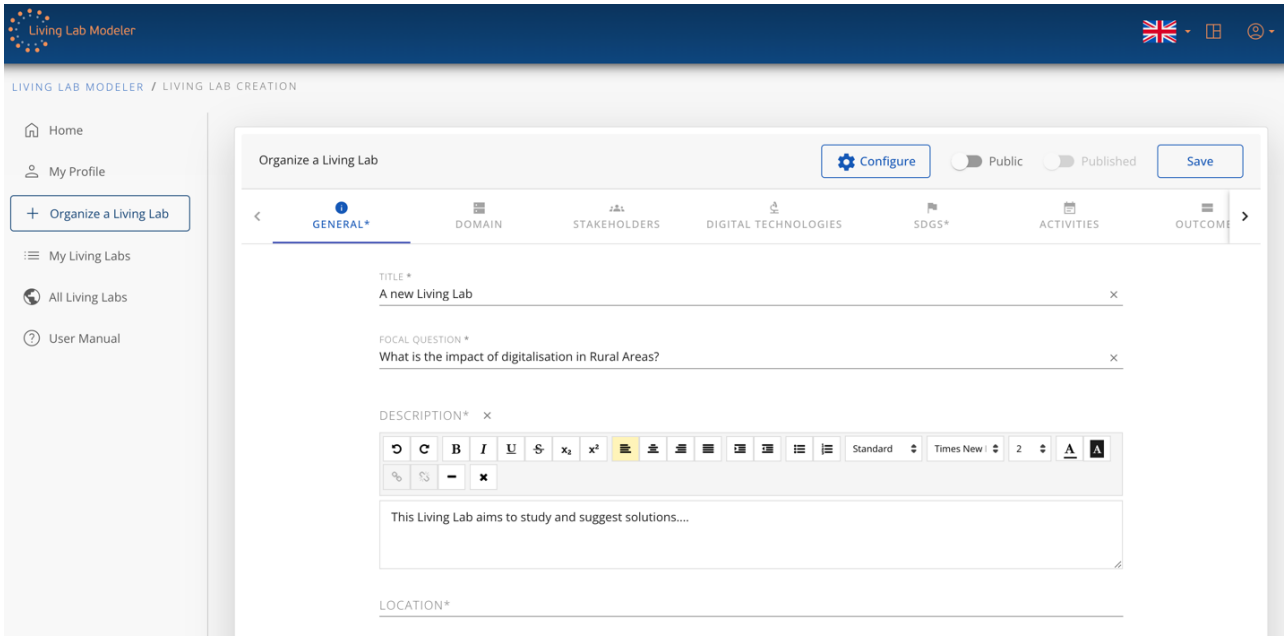

Figure 3: Creating a new Living Lab

3.5 The LLM Modules

Providing maximum feature and view customisation per Living Lab to the users has been a major aim of the LLM. To achieve that, LLM functionality is enabled through a set of functional modules. A module is defined as a unit of functionality, which can be enabled or disabled by the Living Lab organiser during its initialisation. Each module implements a different functionality of a Living Lab and is reflected as a different view in the application side.

Modules, either mandatory or optional, can be instantiated by any Living Lab. The mandatory modules are always enabled, while the optional ones reside on the LL's organiser selection. Each Living Lab consists of mandatory modules such as the General Description, Domain, Stakeholders, Digital Technologies, Sustainable Development Goals (SDGs), Activities and Outcomes modules, and some non-mandatory modules, which currently are the Socio-Cyber-Physical System representation and Poll modules. During the initialisation of a Living Lab, the user can view each module and select to use any of the non-mandatory ones. By encapsulating and extending different Living Lab functionality in our modules, it is easier to implement and extend our system in a step-by-step iterative manner, which allows to mitigate errors and enhance development. We modelled our Living Lab and modules in such a manner that the module-related data persist in case a user disables, stores and therefore re-enables the disabled module. A brief description of the current set of modules follows.

General Information

This module implements the basic descriptive information, mandatory for each LL. It includes its title, a more detailed description, the main focal question / problem statement and its location. This set of information has been selected based on the most important aspects, according to LL coordinators.

Domain

The concept of Living Labs is applicable in various fields such as health, agriculture, climate, and more. This module introduces different classifications for each domain. Users can select the relevant application domain for their Living Lab, and based on the specific classification, they can delve into further details.

Digital Technologies

This module presents the Digital Technologies that are frequently used by LLs, based on the work conducted within the H2020 DESIRA project, to identify digital technologies that can be game changers [Bacco et al., 2020]. Each LL can select all that are relevant to its activities. This is an important information for LLs, considering the contribution of digital technologies in the digital transformation and twin (green and digital) transition.

Socio-Cyber-Physical System

A Social-Cyber-Physical System (SCP S) involves the interlinking of the cyber, physical, and social domains within a system-of-systems mindset. The SCP module supports the modelling of a system through the SCP approach by defining the distinct entities and their interactions [Metta

et al., 2022]. This module offers a representation of the interlinkages between the systems. Similarly to the previous module, it provides useful information as part of the systemic approach to connect digital and physical entities for addressing a challenge in its entirety.

SDGs

Since many of the activities of a LL are working towards the achievement of the UN's Sustainable Development Goals (SDGs), this module enables the option of selecting the relevant SDGs of a LL and it also provides the option to describe the initial and the future impact, after completing the LL activities and producing its outcomes, the LL has on each SDG.

Stakeholders

The stakeholders' mapping process is a crucial activity at the initial phases of a LL and impacts the success of its activities. This module supports the recording of the LL's stakeholders by providing a set of descriptive information together with a custom attributes' list that is defined per LL. The custom attributes provide flexibility and supports the analysis of the stakeholders based on what it matters most for each LL.

Activities

The activities module allows LLs to plan and keep track of their activities & events in a fine-grained manner. Exploiting this module, the LL organiser can make available in one place all the important information of a planned activity and ensure that all participants are informed before it will take place. In addition, the module supports the upload of the outcomes of each activity, thus ensuring that all the actions are recorded and made available.

Outcomes

It is already stated that LLs often fail to externalise their actions and outcomes, limiting their visibility and their potential to be extended outside their initial boundaries. Exploiting this module, a LL can make available all its outcomes, including descriptive information and files for each outcome, and presenting it in one place, easily accessible by anyone.

Reports Generator

This module auto generates a report that includes all information related to the LL activities. This way, it improves efficiency in sharing among interested parties, facilitates knowledge exchange, saves time and effort when it comes to the documentation of activities and contributes to the sustainability of the LL work.

Poll

This module enables the interaction with the members of a LL, through the activation of simple polls and open questions, enabling the collection of opinions on issues that are important for the LL and ensuring the fair participation of all its participants, facilitating their engagement and exchange of experiences.

3.6 The LLM Service and user management

The LLM Service is responsible for incorporating all business logic of the LLM solution, along with managing all user information and LL data related to LLM. It is a multilingual application, supporting the implementation of LLs in their local language increasing the engagement of the local participants.

As depicted in Figure 1, it deploys the Storage and the Authentication/Authorization Service, which is responsible for verifying the identity of each user and then verifying the different user actions based on the roles and permissions of each user in the system and Living Lab level.

To ensure the correct user access, LLM implements a user management system of various levels. We introduced a permission sub-system, where views and actions are allowed or restricted to users that own different permissions. To further simplify user-permission functionality, we introduced different LLM System Roles in a way that new roles mapped with different permissions could be introduced at runtime, depending on the setup and the needs of each LL. We followed the previous approach also for restricting or allowing Living Lab material editing by different LL members, thus we introduced different Living Lab Roles mapped to specific permissions, that occur per Living Lab and user. This allows, among others, a user of the system to hold different LL roles in different Living Labs

The System Roles currently supported are the Administrator, the Living Lab Organiser, the Facilitator and the LL Member. The LLM Administrator role has access to most LLM views and the living lab organiser functionality. The Organiser can create/edit his/her Living Labs, browse public Living Labs, and submit requests to join other Living Labs. Each user that creates a Living Lab has initially the Organiser LL role (for the freshly created Living Lab) and can manage the LL roles of the other participating LL members. A new member will be assigned the LL Member role until the Organiser/Facilitator changes the member's role to another one with more privileges; then the user can perform more actions on LL resources.

A user of the system can browse all the published Living Labs and request membership to a Living Lab in an easy and intuitive way; The Living Lab Organiser will be notified about the new potential member's join request and accept or refuse the request. Additionally, the Living Lab Organiser can decide to promote a member to a Facilitator allowing him/her to gain Living Lab information editing access.

4. Conclusions – next steps

This paper has introduced the Living Lab Modeler, a comprehensive tool designed to effectively manage Living Labs, providing a structured approach to optimise their functioning and outcomes. The first version of LLM had been realised and made available in the context of the H2020 DESIRA project, which setup and run LLs in 18 European countries. The solution has been tested and feedback has been given from these LLs, allowing us to validate the initial concept, design, and developed solution.

Moving forward, further validation and refinement of the tool through even broader real-world implementation and feedback loops are among the priorities for the development team. Efforts in this direction already take place, by implementing instances of the tool in both, ongoing research projects that involve LLs, as well as through the engagement in community-driven innovation activities. Feedback and suggestions have been received from this network and future developments and enhancements are already defined. These enhancements include new modules, including, but not limited to, a data repository for each LL, collaboration, and exchange of experiences among the different LLs, the design and visualisation of innovation pathways and the export of the LL information as an open dataset and publishing it to well-known open repositories that support and embrace the Open Science principles.

The field of innovation management is a dynamic one, with new methodologies and best practices constantly emerging. Therefore, continuous research and adaptation to evolving methodologies and best practices in the field of LL innovation management will be crucial for ensuring the LLM remains relevant and impactful in facilitating the success of Living Labs. Staying abreast of these developments and proactively incorporating relevant insights into the LLM is essential for its long-term relevance and effectiveness.

Additional plans include the exploring of avenues for integration with existing LL management frameworks and solutions, as this could enhance the tool's applicability and scalability. In this direction, the discussions taking place and the frameworks and methodological approaches being developed within networks and initiatives that organise and operate Living Labs, are of outmost importance for the further development of the Living Lab Modeler.

Acknowledgements

The initial phase of this work has been supported by European Union's Horizon 2020 research and innovation programme under grant agreement No. 818194, project DESIRA.

References (APA style in alphabetical order)

1. Ballon, P., Van Hoed, M., & Schuurman, D. (2018). The effectiveness of involving users in digital innovation: Measuring the impact of living labs. Telematics and Informatics, 35(5), 1201-1214.
2. Bacco M., Brunori G., Ferrari A., Koltsida P. and Toli E., "IoT as a Digital Game Changer in Rural Areas: the DESIRA Conceptual Approach," 2020 Global Internet of Things Summit (GIoTS), Dublin, Ireland, 2020, pp. 1-6, doi: 10.1109/GIOTS49054.2020.9119674.
3. Cordis search results, accessed on 09 May 2024 https://cordis.europa.eu/search?q=frameworkProgramme%3D%27HORIZON%27%2C%27H2020%27%20AND%20(%27living%27%20AND%20%27lab%27)&p=1&num=10&srt=Relevance:decreasing

4. Das, P., Verburg, R., Verbraeck, A. and Bonebakker, L. (2018), "Barriers to innovation within large financial services firms: An in-depth study into disruptive and radical innovation projects at a bank", European Journal of Innovation Management, Vol.21 No.1, pp.96-112. https://doi.org/10.1108/EJIM-03-2017-0028.
5. Dewar, R.D. and Dutton, J.E. (1986), "The adoption of radical and incremental innovations: an empirical analysis", Management Science, Vol. 32 No. 11, pp. 1422-1433.
6. Dutilleul, B., Birrer, F. A., & Mensink, W. (2010). Unpacking European living labs: Analysing innovation's social dimensions. Central European Journal of Public Policy, 4(1), 60-85.
7. ENoLL Activity Reports 2014-2022. (2014-2022). European Network of Living Labs.
8. ENoLL Catalogue 2023. (2024). European Network of Living Labs.
9. Gassmann, O., & Enkel, E. (2004). Towards a theory of open innovation: three core process archetypes. Proceedings of the R&D Management Conference, Lisbon, Portugal, 6, 1-18.
10. Leminen, S., Westerlund, M., & Nyström, A. G. (2012). Living Labs as open-innovation networks. Technology Innovation Management Review, 2(9), 6 11.
11. Metta, M., Ciliberti, S., Obi, C., Bartolini, F., Klerkx, L., & Brunori, G. (2022). An integrated socio-cyber-physical system framework to assess responsible digitalisation in agriculture: A first application with Living Labs in Europe. Agricultural Systems, 203, 103533. https://doi.org/10.1016/j.agsy.2022.103533.
12. Niitamo, V. P., Kulkki, S., Eriksson, M., & Hribernik, K. A. (2006). State-of-the-art and good practice in the field of living labs. In Proceedings of the 12th International Conference on Concurrent Enterprising: Innovative Products and Services through Collaborative Networks (pp. 349-357), IEEE.
13. Sawhney, M., & Prandelli, E. (2000). Communities of Creation: Managing Distributed Innovation in Turbulent Markets. California Management Review, 42(4), 24-54. https://doi.org/10.2307/41166052.
14. Schuurman, D., De Marez, L., & Ballon, P. (2016). Living Labs: A Creative and Collaborative Planning Approach. Journal of Innovation Management, 1(1), 1-18.
15. Schuurman, D., De Marez, L., & Ballon, P. (2016). The impact of living lab methodology on open innovation contributions and outcomes. Technology Innovation Management Review, 6(1), 7-16.
16. Schuurman, D. (2015). Bridging the gap between Open and User Innovation?: exploring the value of Living Labs as a means to structure user contribution and manage distributed innovation.
17. Ståhlbröst, A. (2013). A living lab as a service: Creating value for micro-enterprises through collaboration and innovation. Technology Innovation Management Review, 3(11), 37-42. Schuurman, D., De Marez, L., & Ballon, P. (2016). Living Labs: A Creative and Collaborative Planning Approach. Journal of Innovation Management, 1(1), 1-18.