This paper was presented at the XXXV ISPIM Innovation Conference, held in Tallinn, Estonia on 09 June to 12 June 2024. ISBN 978-952-65069-6-8.

Harmonizing Living Lab Services: Towards consolidated service portfolio

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Abstract: Living labs share common elements but have multiple different implementations. Prior studies have revealed a lack of research on effective management approaches for living labs. Service harmonization is suggested as an approach to improve efficiency and to ensure the consistency of services and results regardless of the service provider. This study evaluates the living lab service portfolio and proposes a harmonized service categorization to contribute to ongoing discussions on living lab harmonization. The suggested framework consists of 18 services for Customer acquisition, 13 for Detailed project planning and 29 for Project implementation and dissemination phase as well as 9 repositories in Innovation ecosystem orchestration. Services are also classified into Back-office (N=29), R&D services (N=21), and 3) Auxiliary services (N=4).

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Keywords: Living lab, Harmonization, Service, Servitization, Classification

1 Introduction

According to the European Network of Living Labs – the international federation of benchmarked living labs in Europe and worldwide – living labs are user-centered, open innovation ecosystems based on a systematic user co-creation approach, integrating research and innovation processes in real-life communities and settings. They operate as intermediaries among citizens, research organizations, companies, cities, and regions for joint value co-creation, rapid prototyping, or validation to scale up innovation and businesses. Living labs share common elements but have multiple different implementations.

There are various types of living labs (Alavi et al., 2020), operating in over 20 different domains (ENoLL, 2023), with the most common ones being social innovation and inclusion (Edwards-Schachter et al., 2012), health & well-being (Santonen, 2020), smart cities & regions (Cardone et al., 2014), education and/or vocational training (O'Brien et al., 2021), and environmental and climate change (Santonen et al., 2017). However, prior literature reveals a lack of studies on effective management approaches and reference models for living labs, presenting a critical challenge in developing suitable business models and services for living labs (Hossain et al., 2019). In all, the performance and benefits of living labs are argued to be unclear due to limited empirical evidence (Paskaleva and Cooper, 221; Schuurman et al., 2015).

Living labs show various types of business models (Hossain et al., 2019), with the majority of them relying on sustainable business models, as they operate through project-based funding associated with universities or urban-development agencies. The optimal business model for Living Labs is still under research and development. However, it's worth noting that the servitization of Living Lab business models can bring significant advantages. Living Labs are transitioning from a project-oriented business model to providing services for SMEs, researchers, and public authorities (Pallot et al. 2010). Service innovation in the business-to-business context holds a crucial significance for developing competitive advantages, extending market reach to underrepresented domains, and increasing profits (Kindström et al., 2013). By embracing a service-oriented approach, Living Labs can broaden their impact beyond individual projects, offering ongoing support, expertise, and resources to stakeholders. This shift not only enhances the sustainability of Living Labs but also strengthens their role as innovation hubs and collaborative platforms for co-creating value for various stakeholders (Santonen et al. 2023).

Therefore, the main objective of this study is to propose harmonized service categorization to contribute to ongoing discussions on living lab harmonization and interoperability across diverse living lab initiatives and ecosystems (Vervoort et al., 2022, Kehayia et al., 2023, Petsani et al., 2022; Mulder et al., 2007). Harmonization aims to reconcile differences and promote coherence between multiple practices while allowing more flexibility compared to standardization, which focuses on establishing a single set of specifications. As a result, service harmonization can help improve efficiency, productivity, quality, and scalability, as well as foster collaboration, and better risk management.

2 Living lab services in literature

There is a significant amount of literature discussing how living labs have been utilized to develop services in different contexts (e.g., Nesti, 2018; Akasaka et al., 2020; Lehmann et al., 2015), but only a handful of studies delve into the actual living lab services (Dutilleul et al., 2010). Overall, it has been argued that living lab services and functions are extremely diverse, and lack coordination, leading to overlapping offerings and challenges in meeting current business demands (Grotenhuis, 2017).

A study by Ståhlbröst (2013) evaluated the value of living labs for SMEs and presented examples of living lab services, such as designing idea-generation processes, planning or carrying out real-world tests of innovations, and pre-market launch assessments. The study also identifies roles within a living lab, including manager, panel manager/facilitator, innovation process manager, and researcher, which can be linked to services such as "marketing and sales", "project management", and "panel research". In a panel-based approach within a living lab, panel members are recruited and carefully profiled annually to facilitate user engagement more efficiently (Schuurman et al., 2012). Panel research is a common approach in commercial research services, such as the Gallup Panel, representing the entire national population.

A study by Eschenbächer et al. (2010) argued that living labs lack a defined service portfolio and do not market their services. The study also listed the following services: Project preparation services, Innovation and development services for companies, Meeting places, User development methods, Usability testing, Living lab methods, Online focus groups, Pilot and innovation environment, Project management services, Prototype creation, Prototype testing, Scenario analysis, Need finding, Service concepts, Product development services, Commercialization, and Networking. The most comprehensive study to evaluate living lab service offerings was conducted by Santonen et al. (2020), who developed a classification consisting of seven main categories, including 33 different service items: "Innovation network orchestration and funding support," "Project planning and management," "Market and competitor intelligence services," "Co-creating products, services, and processes," "Testing and validation services," "Business advisory and management consulting," and "Marketing and sales support."

3 Research methodology

A comprehensive multimethod approach, encompassing expert opinions (Kruger et al., 2012), co-creation workshops, surveys, and real-life testing, was employed to gain a holistic understanding of living lab services from the perspectives of both service providers and customers. Experts and living labs were sourced from the Harmonization Body of the Horizon 2020-funded Virtual Health and Wellbeing Living Lab Infrastructure (VITALISE) project. The expert panel comprises individuals possessing specialized knowledge and skills in living lab projects, research, and/or management, acquired through practical experience, study, or expertise (Kangas and Leskinen, 2005). The overarching goal of the VITALISE project is to open up living lab research infrastructures, fostering and advancing research activities in the Health and Wellbeing domain in Europe and beyond. Additionally, the project seeks to harmonize processes and common tools utilized by various living labs. The research process unfolded as follows.

PHASE 1: Construction of the Initial Service Model: Eleven health and wellbeing-focused living labs participated in a survey, providing feedback on 33 distinct service offering descriptions derived from a prior study (Santonen et al., 2020). Living labs had the opportunity to suggest new services and indicate the ones they offered. Initial service descriptions, drawn from literature, were refined based on collected feedback and published on open-access wiki pages. External input was sought through direct invitations and presentations at events, with feedback categorized based on content and wiki page sections.

PHASE 2: Defining and Classifying Services: A face-to-face workshop with experts aimed to establish an initial agreement on services and their categorization. Subsequently, an online co-creation workshop finalized the definitions, as eight service categories had emerged, each with a slightly different name.

PHASE 3: Real-life Testing with Living Lab Customers: The robustness of service offerings underwent testing through an open-call process. Nine living labs, providing 17 research infrastructures, allowed external researchers to conduct Transnational Access (TA) research projects using their services via an open-call approach. In their project proposals applicants indicated the services they intended to use. During and after the project both applicants and living labs provided feedback. As a result, a need to classify services into "R&D services", "Back-office," and "Auxiliary," services were identified. Input-output feeds for each service were identified, and the logical relationship between different services was visualized to understand the living lab project process flow. A face-to-face co-creation workshop with expert groups facilitated discussions, improvements, and agreements on the newly added items and their definitions.

PHASE 4: Co-creation with Living Labs: The nine living labs populated a Miro board with information on processes and services used in completed TA projects. An online co-creation workshop followed, allowing discussion, feedback, and suggestions for refinements to the current service model and its visualization until a consensus was reached. Afterwards, multiple feedback loop iterations were needed to make minor additions when new services were discovered.

4 Results

4.1 PHASE 1 results: Evaluating the Initial Service Model

The results in Figure 1 indicate, that there was great variation among the sample group how many services they were offering. This finding supports the prior findings in the literature.

Table 1 presents in more detail how popular the initial services were among the sample living labs (Santonen et al., 2020). The comprehensibility of service titles and descriptions was evaluated by calculating the number of comments for each service. Out of 34 service titles, 14 titles (41%) didn’t receive any title change suggestions, 16 titles (47%) gained one suggestion, 2 titles (6%), including “Observations, shadowing, and ethnography studies” and “Funding,” had two suggestion, and 2 titles (6%), including “Briefing” and “Panel research,” had three suggestions. As a result, it is argued that the suggested titles were received well among the sample group.

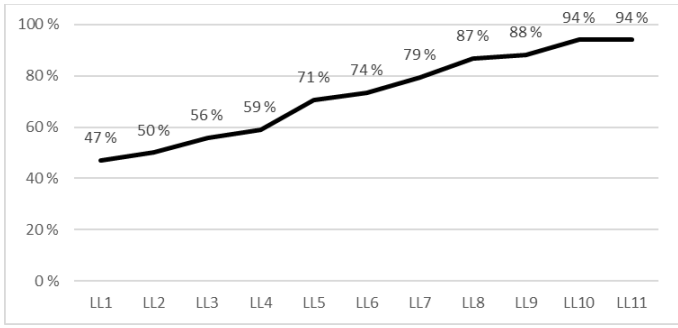

Figure 1 Existence of services comparison among the sample group

Table 1 Living lab service popularity among sample living labs

% of LL offering service	*N*	*Services*
100 %	11	Interviews and focus groups, Living lab project planning and management, Small-scale real-life testing and experimentation, Stakeholder (and partner) analysis and mapping, Surveys
80 % or more	9-10	Briefing, Expert opinion, sparring and advisory services, Innovation network orchestration, Large-scale real-life testing and piloting, Co-creation workshop, Customer journey, Idea selection and testing, Impact assessment and validation test, Panel research, Prototyping test, Simulation test, Usability testing, User personas
70 % or more	8	Concept and proof-of-concept tests – feasibility study, Grant writing, and funding application support service, Hackathon and design sprints, Observations, shadowing, and ethnography studies
50 % or more	6-7	Access to data, Capacity building, Clinical trials , Competitor and market analysis and benchmarking, Regulatory approval tests, Equipment and facility rental service
30 % or more	4-5	Legal, regulation, and safety standard support, Foresighting (trends, weak signals, and wild cards), Marketing and sales support, Post-market surveillance and market acceptance testing, Public procurement support services
18%	2	Funding

In total, experts also gave 216 comments for service descriptions which covered service additions, generic comments, and improvement suggestions for service descriptions. Based on the qualitative analysis, the following new service suggestions were identified: 1) Measurement of social, environmental, and socioeconomic impact (SROI), which extends the existing "Impact assessment and validation test", 2) Longitudinal data collection involving repeated observations of the same variables (e.g., people) over short or long periods, 3) Ethical approval support, 4) Research design/protocol definition and Data management planning, which are sub-tasks within Living lab project planning service, 5) Cross-border collaboration facilitation which provides an international viewpoint for Innovation network orchestration, 6) Technology and scientific research results

transfer/consulting services helping to commercialize scientific results including e.g. patent and trademark processes, finding partners and clients, 7) Innovation transfer focusing on planning and executing scalability and transferability after the originating living lab process has finished. Both of these transfer services also be considered as part of the expert services and 8) Procurement up-scaling, which is an extension to existing Public procurement support services.

4.2 PHASE 2 results: Living lab services classification

As a result of phase 2, the following eight (8) category names relating to different services were defined.

Table 1 Living lab service classification

% of LL offering service	*Services*
Testing and validation	Access to data, Concept and proof-of-concept tests – concept feasibility study, Clinical trials, idea selection and testing, Impact assessment and validation test, Large-scale real-life testing and piloting, Prototyping test, Simulation test, Small-scale real-life testing and experimentation, Usability testing
Community and network building	Innovation network orchestration
Project planning and management	Expert opinion, and advisory services
Co-creation	Co-creation session, Concept and proof-of-concept tests – concept feasibility study, Idea selection and testing
Capacity building	Co-creation session, Capacity building, Expert opinion, and advisory services, Innovation network orchestration
Advisory services	Grant writing and funding application support service, Competitor and market analysis and benchmarking, Expert opinion, and advisory services, Temporary research funding, Legal, regulation, and safety standard support
Market and sales support	Access to data, Competitor and market analysis and benchmarking, Expert opinion, and advisory services, Foresighting (trends, weak signals, and wild cards), Marketing and sales support, Post-market surveillance, and market acceptance testing
Infrastructure and data management	Access to data

All participants agreed that the *"Testing and Validation"* category will include all the crucial information related to research activities within LLs. "Project planning and management" seemed to be a category, which almost all participants agreed to be a vital service category within a living lab. "Network scalability" and "Community and network building" were also categories that all participants agreed were relevant to LLs' activities and should be included in the classification and named "*Community and network building*".

Regarding the "*co-creation*" category, there was a discussion regarding its terminology ("What does co-creation really mean?"). There was a controversy between the technical and practical meaning of the term/method "co-creation" as, while the technical definition is widespread, some participants believed that in practice, the term "co-creation" may interfere with the communication between researchers. Considering that differences in co-creation methodologies and procedures greatly impact the harmonized processes in LLs, the participants strongly believed that there should be a discussion to combine said differences in a common language and concluded in the category name "co-creation" to which a variety of services and methodologies will be included. The "*Advisory services*" category aims to provide help and support living lab customers in many aspects and can include a wide range of services. Most participants agreed that the "Network and capacity building" category, as characterized in the existing standard, would be renamed "Training/Network capacity building" or "Capacity building".

4.3 PHASE 3 results: Re-classification based on real-life feedback

Based on comments derived from the Open Calls applicants and living labs offering them services, a misunderstanding among the several services was identified. To clarify this issue, services were classified into R&D, Back-office, and Auxiliary services and a distinction between customer acquisition, detailed project planning, and Project implementation and dissemination phases was also made as presented in Table 1.

Table 1 Living lab service classification and services

Customer acquisition	*Detailed project planning*	*Project implementation and dissemination*
	R&D services	
Stakeholder analysis*, Access to data, Capacity building, Equipment and facility rental service, Intake and matching	Stakeholder analysis*	Stakeholder analysis*, Clinical trials, Co-creation sessions, Competitor and market analysis, and benchmarking, Concept and proof-of-concept tests – feasibility study, Expert opinion, and advisory services, Foresighting (trends, weak signals, and wild cards), Idea selection and testing, Impact assessment and validation test, Large-scale real-life testing and piloting, Legal, regulation and safety standard support, Post-market surveillance and market acceptance testing, Prototyping test, Public procurement support services, Simulation test, Small-scale real-life testing and experimentation, Usability testing

* Service covers multiple process phases

Table 1 (continue) Living lab service classification and services

Customer acquisition	*Detailed project planning*	*Project implementation and dissemination*
	Back-office service	
Innovation network orchestration*,	Innovation network orchestration*,	Innovation network orchestration*,
Desk / Market research*,	Desk / Market research *,	
	IPR management*,	IPR management*,
Application evaluation, Contract / Consortium agreement, Funding call monitoring, Grant writing / Preparation, Maintenance, Marketing, sales, and networking support, Offer preparation, Subcontracting negotiation process, Temporary research funding	Access management, Data governance policy, Data management plan, Detailed project planning, Ethical application preparation, Research protocol design, Resource allocation	Data analysis**,** Data anonymization, and pseudonymization, Data cleaning, Dissemination, Fair data compliance process, Living lab project management, Panel management, Quality and risk management, Results reporting / Publication writing, Stakeholder engagement
	Auxiliary services	
Funding application process, Funding call information	Ethics committee review, Research site permit	

* Service covers multiple process phases

Back-office services refer to service processes, which take place behind the scenes and do not directly include direct customer interaction. This category covers a wide range of tasks to support R&D activities. *Auxiliary services* refer to those services, which provide the necessary support for living labs, as auxiliary processes, to ensure that a research study will run safely and ethically. R&D services refer to a process to generate new knowledge, which can be used to innovate and introduce new technology, products, services, or systems - or to improve their existing offerings - which, afterwards, will be either used or sold.

4.3 PHASE 4 results: Visualization of logical relationships between living lab services

Input and output feeds for each service were defined to visualize the logical relationships between living lab services during customer acquisition, detailed project planning, project implementation and dissemination. Visualization is presented in Appendix 1.

Customer touchpoints: Living lab Business-to-Business Customer (B2B) service customer is a person or organization who purchases or uses living lab research infrastructure services to conduct a living lab project. These customers consist of private, public, education/ research, civil society organizations, and networks/cluster customers or funding organizations. The following seven customer touchpoints were identified: 1) Need for contacts, 2) Need for data, 3) Learning interest, 4) Need for equipment or facility, 5) Research/Innovation need or idea, 6) Market entry/Uptake plan, and 7) Funding need.

Customer acquisition: Various marketing and external communication activities are carried out to reach out to customers and make them aware of the following access options: *Market-driven access* includes a fee for the access and the outcome of the study may remain confidential. During "Intake and matching", the customer's (e.g., a company, SME, a start-up, a researcher) development and testing needs are clarified for project planning purposes in a co-creative manner to make sure that Living Lab capabilities match the needs. This information forms a foundation for offering preparation. "Equipment and facility rental", "Capacity building" and "Marketing, sales and networking support" are examples of market-driven access services. *Excellence-driven access* mode grants access based on peer-reviewed scientific excellence or some other predefined criteria. Open calls are typically utilized to provide Excellence-driven access which matches well with "Funding needs" and "Research/Innovation needs or idea" touchpoints. In the *Wide access* option, the living lab endeavours to provide the broadest possible access to its services, including open data through the "Access to data" service.

Most living lab revenues are coming from publicly funded projects. Therefore, "Grant writing/preparation", "Funding call monitoring" and "Evidence-based lobbying" are critical living lab services. Sometimes "Desk/Market research", "Stakeholder analysis" and "IPR management" can be addressed already during the customer acquisition, although they more commonly are conducted during the detailed project planning phase.

Detailed project planning: This phase creates detailed plans to carry out the project including "Research protocol design", "Data governance policy", "Data management plan", "Resource allocation", "Quality and risk management", "Ethical application process" and "Research site permit" services as well as "Desk/Market research", "Stakeholder analysis" and "IPR management" which overlap with the customer acquisition phase. The project plan output serves as a detailed roadmap for guiding the project from initiation to completion.

Project implementation and dissemination: "Project, quality and risk management" back-office services involve organizing, directing, and controlling resources during a whole project lifecycle to achieve goals and objectives within defined requirements, expectations, schedules, and budgets. The key components of a living lab project are users and other key stakeholders relevant to the project scope. Both ad hoc and permanent user panels are utilised where the latter includes a pre-existing group of pre-screened people who have given their consent to take part in different research activities over an agreed period. The actual research and development work consisting of iterative co-creation and testing follows a multimethod approach while aiming to transform solutions (i.e., technology, service, process or similar) from lower to higher technology readiness levels (TRL). Respectively as in any research project, the collected data will undergo "Data cleaning", "Data analysis", and "Data anonymisation and pseudonymisation" processes. Depending on the selected access option, "Result reporting/Publication writing" can lead to fully confidential, partially confidential, or open outcomes. Lately, the requirement to publish "FAIR data" has also become more and more common.

5 Conclusions

Existing literature reveals a lack of studies on effective management approaches and reference models for living labs, presenting a critical challenge in developing suitable business models for living labs (Hossain et al., 2019). This study proposes the

categorization of living lab services to contribute to the ongoing discussions on living lab harmonization. Visualization of logical relationships between different living lab services consists of four phases: 1) Customer acquisition (18 services), 2) Detailed project planning (13 services), 3) Project implementation and dissemination (29 services), and 4) Innovation ecosystem orchestration (9 repositories). Services are classified into the following three groups: 1) Back-office services (N=29) (administrative and support functions), 2) Research & Development services (N=21) (collaborative generation of new knowledge), and 3) Auxiliary services (N=4) (auxiliary processes for ensuring safe and ethical living lab operations). The outcome of this study can foster interoperability and collaboration across diverse living lab initiatives and ecosystems by suggesting a common approach to describe and measure living lab services. Practitioners will benefit from a clear and organized service model that facilitates communication, decision-making, and strategic planning within their living lab context. In the long run harmonization of services facilitates interoperability, enhances collaboration, and streamlines operations among living labs, promoting a more cohesive and efficient innovation ecosystem.

Acknowledgements:
This work was supported by the VITALISE and FARCLIMATE projects that have received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No. 101007990 and from the European Union's HORIZON EUROPE Research and Innovation Actions under Grant Agreement No. 101112860.

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Appendix 1: Visualization of Living Lab Services