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# Living Labs (as Intermediary Organizations) and the Phenomena of Inclusion: Not an Easy Journey

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## Abstract

The emergence of Living Labs (LL), now present on several continents, has given rise to a large body of academic and practionnal works over the past decade. Leminen and Westerlund (2019) have been able to trace this movement since its emergence in the early 2000s. The phenomenon of inclusion is cited in many papers as the crux of a Living Lab, which allows this organization to generate a 'relevant' common good. However, very little research has explored this phenomenon. This qualitative study aims to define inclusion in LL and its contribution, as well as the challenges associated with inclusion in LL. The study attempts to describe these dimensions by first identifying what inclusion means in the context of some urban LLs. The findings show that inclusion in LL is about knowledge, stakeholders and social inclusion. It brings individual and collective benefits, and knowledge sharing and perceptions of inclusion are among the challenges to be overcome. The study is exploratory, based on a broad review of recent cross-literature as well as secondary data and expert feedback. The approach is both theoretical and empirical. Data processing is carried out through cross-checking and grouping.

**Keywords:** living lab, intermediary organization, inclusion, stakeholders, knowledge.

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## 1 Introduction

As an organization, the Living Lab (LL) has been characterised and discussed several times. A LL can be described as an 'intermediary' organization in which a variety of actors - referred to in this text as stakeholders - work together to produce a common innovative artefact. According to Klerkx and Leeuwis (2008), intermediary organizations are essential for managing the complexity inherent in innovation ecosystems. They have the unique ability to integrate different knowledge domains, stimulate collaborative learning and manage uncertainty. The facilitative stance of these organizations is therefore crucial for supporting, guiding and amplifying innovation throughout the ecosystem.

Thus, the phenomenon of inclusiveness or inclusion is often associated with LLs, as it is in much recent research on organizations (Dobusch, 2014; Adamson and al., 2021). Inclusion is frequently considered a fundamental aspect of a Living Lab, enabling the development of an artefact that is collaboratively constructed and aligned with anchored uses in a specific area, such as a city or community.

But if the phenomenon of inclusion is often discussed in the broad literature of organizational studies, how is inclusion expressed within a Living Lab? What is its contribution? What are the

difficulties and challenges associated with inclusion, which seems to be a crucial element for an LL? The current literature on LLs has brought these questions to life and invites to explore them.

## 2 Literature review

### 2.1 The Living Lab, many definitions but pointing (towards) collective action

As Leminen and Westerlund explain in their 2019 article tracing the history of the Living Lab movement, LL are now an integral part of the current landscape of organizations in the knowledge and ideas economy. They are becoming places where citizens participate in building collective responses to societal needs. Living Labs have become increasingly common in cities, with varying degrees of participation in the final decision (Arnstein, 1969). They are also supported by European programmes, including in rural areas where LLs have proved their worth, as in the case of the LIVE RUR programme. The sponsors of these LLs are sometimes public and sometimes private, and in most cases, they are initiated through partnerships between associations, citizens, public authorities and private companies.

The collective nature of the LL is based on the place of the users and the adoption of a co-development attitude. The definition promulgated by the Helsinki Research Centre (2004) underlines this dimension: *"A Living Lab is a system for building the future innovation environment, where real-life user-driven research and innovation will be a normal co-creation technique for new products, services and social infrastructure"*. De Vita and De Vita (2021) explained that "the ecosystem of stakeholders to be integrated" in a LL, although complex, is what makes innovation possible.

A Living Lab may be conceived as a series of "organized" collective workshops that convene multiple stakeholders with diverse knowledge with the objective of producing an innovative artifact that can ultimately be implemented and managed by the stakeholders themselves. The exploration of the needs, which are often either latent or unarticulated, that underpin the implementation of an LL is a collective endeavour, as is the implementation of the innovation that emerges from this process. At the core of this approach, which entails the participation of researchers, elected politicians, public officials, experts, business leaders, and members of civil society, are the users. In their 2012 paper, Ståhlbröst and Holst put forth the idea of viewing the functioning of a Living Lab as an iterative spiral comprising multiple loops, the number of which varies depending on the circumstances. This process begins with the organization of the Living Lab itself (planning) and culminates in the marketing or implementation of the innovations produced through this Living Lab (commercialisation).

However, the concept of a Living Lab is subject to variation according to the scale of application and the perspectives of theorists and practitioners (Niitamo, 2006). Several researchers have proposed that there are different configurations of LLs. For example, Leminen (2015) describes Living Labs based on different characteristics, including purpose, organization, action, outcomes and lifespan. This researcher identifies four distinct categories of LLs, which can be described as 'user-driven', 'enabler-driven', 'provider-driven', and 'user-driven. These categories differ from conventional forms of innovation, such as testbeds, as they emphasize a different approach to user and stakeholder involvement. However, above all, they involve "multiple stakeholders" who can play "multiple roles" in a process or space-time in which "collaboration" remains a fundamental aspect.

According to Ståhlbröst and Holst (2012), some seminal researchers in the field of LLs, both at the theoretical and praxeological level, an LL must adhere to five principles to be functional. These five principles are as follows: *Value* (source of value for users), *Influence* (coming from users and

other committed stakeholders (to be taken in account to respond to societal issues), *Sustainability* (for a responsible future, essential for economic, environmental, and social development), *Openness* (coming from initiators and sponsors, oriented towards the active participation of stakeholders and valuing divergent ideas), and *Realism* (linked to the solution anchoring). Among these five key issues, *a minima*, *Influence* and *Openness* call for collective action.

Additionally, The European Commission's Openlivinglabs.eu (see website) has adopted a definition that emphasises the collective "nature" of LLs, noting that "*Living Labs are about societal involvement, about promoting innovation in a societal basis, involving academia, SMEs, public institutions and large companies (. . . ). This is how Living Labs aim to contribute to a new innovation system where users and citizens become active actors and not only passive receivers*."

## 2.2 LL as an intermediary organization

The definitions of an LL that are most widely accepted appear to correspond to Barnard's (1938) definition of an organization in the first sense. Nevertheless, in the scientific and practice-based literature on LLs, researchers have only been considering and analysing LLs as organizations for approximately ten years. It is crucial to acknowledge that organizations are not inherently neutral entities (Acker, 2006). They are the result of social construction. From this perspective, Özbilgin (2009) proposes that inclusion should be conceptualised as a 'relational construct', rather than as an intrinsic representation of social reality.

LLs are sometimes referred to as hybrid forms of organization, innovative organizations or learning organizations. The most prevalent form is that of an intermediate organization, which serves as an intermediary between various entities or groups traditionally addressed in organizational theory. Howell (2006) is one of several scholars who characterise intermediaries as individuals or organizations that facilitate innovation activities between multiple parties. Poncet (2010) posits that this individual or institution may engage in the advancement of innovation through the dissemination of information, knowledge, advice, financing, or by assuming the role of a mediator. This aligns with the findings of Klerkx and Leeuwis (2008) on "innovation intermediaries."

Intermediary organizations, with their facilitator posture, are an crucial component of the ecosystem, facilitating the dynamics of the system. They create links, solve problems and fuel innovation by bringing together different players and encouraging synergy between them. They simultaneously act as a mediator, a creator of links and mutual collaboration, and a resource.

As an intermediary organization, the Living Lab (LL) plays a pivotal role in fostering territorial innovation in rural and peri-urban environments. Some authors, such as Fasshauer and Zadra-Veil (2019), view Living Labs as open innovation intermediaries, whose attributes facilitate the integration of a diverse range of actors, including public institutions, private companies, associations, and citizens, into innovation projects within a specific geographical area.

In the view of Tremblay, Cyr, Cohendet and Simon (2022), who examine LLs as "open innovation intermediaries", the LL may be conceived as a hybrid form of organization, combining formal organizational structures and a community-based mode of operation. In a previous study, Almirall and Wareham (2011) had traced this definition, considering LLs as "meso-type" organizations.

In the view of Berthou and Picard (2017, p. 68), who study LLs in the context of health and autonomy (LLSA), these Living Labs can also be regarded as intermediary or third-party organizations: *"Based on open innovation, these Living Labs propose an organizational model that combines the mobilisation of a wide range of stakeholders in the field of healthcare provision and the contribution of users to its design, in a more collaborative and open logic. Living Labs are third-party entities that occupy a significant place in the healthcare system because of their*

*desire to produce innovation."* They proposed that the innovation process in these types of Living Labs is based on collaboration and openness, rather than on a closed, ownership approach.

It is important to note that several "organizing" perspectives coexist in the literature on LLs: structural perspectives, which are oriented towards legal entities, governance, places, and spaces, and organizing perspectives, which are oriented towards processes and systems. This distinction is exemplified by the work of Tsoukas and Chia (2002), who adopt a processual approach to understanding organizations. The work of Ståhlbröst and Holst (2012), which regards the LL as an open system, represents another example of the "organizing" perspective. At times, the perspectives overlap. For instance, Leminen and Westerlund (2019) view the LL as a system, a process, and an organization simultaneously. For his part, Schuurman (2015) considers that a LL includes *"the LL organization, the LL project(s), and the individual user and stakeholder activities".*

## 2.3 Inclusion in organizations today

The topic of organizational participation has been a subject of investigation by researchers for some time. The issue was first raised by March and Simon in their 1958 book, *Organizations*. Since then, numerous scientific authors have discussed this issue (Taylor, 1989; Glew and al., 1995; Ramsay, 2005). Over the course of several decades, the majority of these authors studied communication as a path to participation, with communication being defined as interaction. The concepts of "medi-action" and "communic'action" were created (Carontini, 1984; Anquetil, 2013) to express the idea that words create action (Austin, 1962). Nevertheless, participation in organizations has become a prevalent phenomenon, prompting some researchers to caution against the "obligation to participate" (Carrel, 2017). In the field of change management, participation is now regarded as a standard practice for achieving success. The involvement of stakeholders in the design and/or implementation of change allows for a greater understanding and acceptance of the proposed changes (Lehmann, 2010).

Participation is frequently evaluated through surveys and observations (Tréhorel, 2007). Autissier and Moutot (2017) propose a tool designated the "baromêtre ICAP" (I for information, C for communication, A for adhesion, P for participation) to measure stakeholders' participation throughout the lifespan of a change project (Autissier, Moutot, 2017). The impact of participation on project success has also been evaluated. Lehmann (2017) suggests that, in the context of weather-related issues such as flooding, it is more efficacious to actively involve citizens than to merely provide them with information.

In the field of project risk management, participation is now widely acknowledged as a means of fostering social acceptability and engagement with all stakeholders (Lehmann, 2022). Moreover, numerous researchers in the field of educational science have demonstrated the superiority of participatory activities over traditional one-way teaching methods. This is because they facilitate the individual acquisition of knowledge, enhance memory retention, and contribute to greater satisfaction.

More recently, several researchers have observed that contemporary organizations not only adopt participatory practices but also that inclusion has become a common practice within management and human resources strategy (Autissier and al., 2019). In several works, inclusive organizations are considered as healthy organizations, that is, able to evolve or grow without tears (Beauchamp and al., 2016). Inclusive organizations are frequently depicted as agile and learning organizations. Some researchers argue that the internal capabilities of such organizations are enhanced due to the sustained promotion of collaboration, collective action, and ethical values. Other authors argue that by promoting inclusion, organizations can more readily achieve

transformation and innovation. The enhancement of social capital and the acquisition of long-term capabilities for survival represent two additional key benefits for these organizations.

In the field of organizational studies, the concept of inclusion is frequently associated to that of diversity. However, as Adamson and al. (2021) have point out, the concept of inclusion is not contingent on the mere presence of diversity. For Ferdman (2017, p. 235), *"In inclusive organizations and societies, people of all identities and many styles can be fully themselves while contributing to the larger collective as valued and full members."*

Ferdman (2017, p. 240) underlines the importance of recognizing that the experience and interpretation of inclusion may vary contingent on the specific type of group or aspect of diversity under consideration. Furthermore, this researcher emphasizes the necessity to view inclusion as a complex process, taking into account the various processes and contexts at different levels – macro, meso, and micro – ranging from ideologies, values, policies, and social and organizational practices to leadership models and group norms.

Lirio and al. (2008, p. 443) argue that inclusion occurs when *"individuals feel a sense of belonging and inclusive behaviors, such as valuing and acknowledging the contributions of all employees, are an integral part of the organization's daily life."* For these authors, "a sense of belonging" is linked to the importance of feeling welcomed, valued, and included in a space that is comfortable for everyone. The perception of inclusion may vary depending on the involvement of different actors in the implementation and decision-making processes.

However, the study of inclusion in organizations, including its critical examination, remains an emerging field of study (Adamson and al., 2021; Dobusch, 2014; Ortlieb, Sieben, 2014). As Shore and al. (2018) mention, there is growing interest in inclusion among researchers, but the literature is still in its infancy. Only a few current works discuss the "reality" or "realism" of inclusion in organizations (Adamson and al., 2021).

## 2.4 Living Lab and inclusion, a "natural" pairing?

For the vast majority of authors engaged in the study or practice of Living Labs, the concepts of inclusion and Living Labs are inextricably linked. This phenomenon can be attributed to the fact that these two concepts are founded upon a definition that encompasses the combination of knowledge, ideas, and individuals from a diverse range of backgrounds. The fact that the concept of LL is based, among other things, on the notion of socially distributed knowledge, as presented by Trépos (1996), also led many researchers to view LL as an inclusive cell. According to Trépos, each person possesses knowledge (experts, laymen, insiders, others) that should be combined and cross-fertilized, in order to establish a shared vision of a problem and the creation of a common artifact.

Furthermore, as cross-fertilisation nourished by different experiences and knowledge will produce ideas for realistic solutions that the people involved in a LL are willing to implement (Schuurman, 2015), it seems reasonable to suggest that the LL cannot function without inclusion (of knowledge and stakeholders). Given the multitude of diverse stakeholders engaged in an LL, collectively and repeatedly involved in co-creation, exploration, experimentation, and evaluation of the various options conceived by the collective, it appears that inclusion represents a constitutive component of an LL.

It is noteworthy that the participation of multiple stakeholders and users in Living Labs (LLs) has been a subject of numerous debates within the scientific literature. Ballon and Schuurman (2015) and Georges and al. (2015) have highlighted the importance of multi-stakeholder engagement and user participation in LLs. In a more recent contribution. Akasaka and al. (2022) sought to describe the key elements to be considered when configuring participation in LLs. They proposed

that it is essential to define the stakeholders to be involved, as well as the motivation management and locations, before defining the participatory features.

As the International Association for Public Participation points out, in reference to the Arnstein model, a variety of techniques can be employed to facilitate or sustain participation. These can be conceptualised as distinct approaches to engagement, namely consultation, involvement, collaboration and empowerment. A plethora of tools, both onsite and online, correspond to each of these approaches. Information repositories, public debate, dialogue techniques, interactive platforms, deliberative forums, creative workshops, design thinking, World Café, personas, futures literati sessions, open spaces, didactic canvases, committee reports, advisory groups, polling processes, and appreciative inquiry processes are among the tools that may be relevant for a Living Lab. The relevance of these tools is contingent upon the specific circumstances at hand, as explained by Akasaka and al. (2022).

In measuring participation in Living Labs, it appears that the same tools are employed as are used to measure participation in change projects. While there is a body of literature that addresses the measurement of participation in LLs and the use of a variety of tools to do so (surveys, individual interviews, and participant observation), there is a paucity of literature that addresses and discusses the impact of stakeholder participation. As stakeholders participate in the process, appreciative inquiry and other qualitative tools could be employed to assess the impact of their involvement. However, it is challenging to identify a study that has focused on the impact of stakeholder involvement. A research report on this topic (Frangioni and al., 2016) indicates that project outcomes, the formation of professional networks, and economic growth appear to be the more discernible impacts associated with citizens' active involvement in a large urban LL like JeFaisMontreal. Furthermore, the report indicates that it is challenging to conduct an impact assessment of the immediate impact of public engagement and in such open processes due to the numerous iterations and the constant influx and departure of stakeholders. This report characterizes inclusion as a fundamental aspect of the project, yet no quantitative or qualitative assessment has been conducted to substantiate this assertion.

However, the literature on LL, whether scientific or praxeological, does not stop at assuming inclusion in a LL, it makes it explicit and sometimes demands it. Steen and van Bueren (2017) argue that the inclusion of multidisciplinary stakeholders will provide “more integrated solutions”. In their book Urban Living Labs, Aernouts and al. (2023, p. 90) emphasize that: "*The body of work on living labs gathers heterogeneous elements: from landscapes to real-life environments, from methodologies to the inclusion of public and private stakeholders*...". Del Vecchio and al. (2017) explain that Living Labs are designed to offer useful implications in the design and launch of regional development policies. Such policies are based on the inclusion of a plurality of users.

The idea that LL and inclusion evoke a "natural" pairing also finds its way into numerous handbooks on LL. A notable example is the “Guide des bonnes pratiques du Living Lab” produced by the INSOLL research project (end of 2017, Belgium). The authors of the guide provide a list of the components of an LL as follows: *"The research and development of solutions to the unmet needs of a population; the involvement of all stakeholders affected by a problem: The Living Lab gathers a plurality of perspectives; the active involvement of users, also called end-users, from the beginning and throughout the innovation process; (. . . ); the use of participatory methods to promote the co-creation of solutions with all stakeholders concerned, including users; the consideration of the context surrounding the issue."*(INSOLL, 2017, p. 2)

In the preliminary interviews conducted for this study, all experts in LL asserted that the concept of inclusion is an inherent aspect of the LL methodology. The practitioners who co-created the "Marqueurs Living Lab," which represents eight criteria for evaluating the performance and quality

of any LL, indicated that inclusion is one of their primary concerns. In their view, the concept of inclusion is associated with two of the criteria they have identified: "Plurality of stakeholders" and "Implications of stakeholders" (Henry and al., 2021). In their 2017 documentation, the experts who co-wrote the "Guide des bonnes pratiques du Living Lab" place considerable emphasis on the importance of stakeholder inclusion in numerous key areas of an LL, including recruitment, motivation management, knowledge sharing, participatory methods, and governance features. A significant number of members of the European Network of Living Labs have indicated that inclusion is now perceived as a crucial aspect of their own Living Labs. Nevertheless, achieving this in practice is frequently challenging.

In conclusion, the literature reviewed here, along with the various statements made by researchers from Almirall and al. (2012) to Lehmann (2022) and Leminen and Westerlund (2019), who have been actively discussing Living Labs for the last decade, as well as the results of their respective work, suggests that, under the right circumstances, an LL can be an inherently inclusive organization. However, the concept of inclusion as it pertains to an intermediary organization, namely the LL, remains to be defined. This is particularly relevant given that inclusion could vary from one LL to another one. As Niitamo (2006) and Leminen (2015) have noted, LLs can vary in terms of size, duration, and format. These preceding points serve as the foundation for this exploratory research.

## 3 Objectives and methodology

Given the prevalence of discussions on inclusion in organizational studies, it seems crucial to investigate the way in which this phenomenon manifests in the context of LLs, which are frequently identified as intermediary organizations. In consideration of the recent scientific advances concerning LLs, which are rapidly expanding and often emphasize inclusivity, and the current trend to promote inclusion in organizations, it is relevant to question the notion of inclusion in LLs at both the conceptual and empirical levels.

The present study therefore aims to identify the notions of inclusion associated with LLs and the forms that inclusion takes within LLs, to identify the contribution of stakeholder inclusion in a LL and to identify the difficulties and challenges in "achieving" stakeholder inclusion in a LL.

The study is “comprehensive” (Dumez, 2016) and employs a mixed-methods approach that incorporates a review of both scientific and praxeological texts (Tashakkori, Teddlie, 2003). These two authors advocate for the use of diverse documentation types to enrich conceptual guides in qualitative studies.

This qualitative approach allows for a deeper examination of specific concepts and a focus on sense-making and the role of humans as active actors. In their 2022 paper, Walsh and Rower argue that qualitative approaches need to be enhanced: *“it is important to develop approaches, methods and/or guidelines that can increase trustworthiness in what we already know about a topic, guide the interpretation of results, and help focus more rapidly on the in-depth understanding of the topic. There is a need for reviews that achieve both depth of insights and a good level of systematicity in describing a phenomenon, or its theoretical understanding or explanation”* (p. 2).

To this end, they proposed a methodology concept combining bibliometrics and grounded theory to conduct a literature review. This innovative concept enabled this study to obtain an in-depth understanding of the current state of research in the field of LL (with a focus on inclusion) through an analysis of a substantial corpus of articles published over the previous decade (Walsh, Taupin, 2018). This entailed not only an examination of the citations from the articles collected, but also a linking of the documents and clustering them, with the objective of facilitating a more

comprehensive understanding and association of the ideas expressed in these texts. Given that a portion of this method is based on the study of co-occurrences of bibliographic references, it was relatively straightforward to identify significant texts and associations of pivotal concepts.

With reference to grounded theory, the usual five stages were followed: defining, searching, selecting, analysing and presenting. As open coding is part of the method, some documents were collected independently of the keywords mentioned below.

In terms of methodology, this study also borrows some concepts related to ANT (Actor-Network-Theory), which emphasises the role of actors in contexts, as explained by Mol (2010). ANT has already been used by some authors to study participation in LLs, such as Fasshauer and Zadra-Veil (2020) in their study of a Living Lab in a rural context. The concept of translation, which is part of Actor-Network Theory (ANT) permits here to understand how the interests of different stakeholders converge through iterative exchanges in a co-construction process, and thus to better understand inclusion phenomena.

Specifically, this research is based on a recent in-depth literature review, including 123 articles and 16 other documents, as well as secondary data and expert knowledge. Twelve different scientific journals were consulted (see bibliography).

Various keywords were used and overlapped to facilitate data collection: Living Lab and inclusion, Living Lab and inclusiveness, participatory methods and tools, intermediary organization and participation, and so forth. The words and expressions: Open Labs, Learning Lab, Innovation Labs have been excluded during the process. In the initial iteration, keywords such as engagement, involvement were excluded in order to prioritise the focus on inclusion.

Most of the Living Labs at the centre of this research are related to urban projects, social innovation, health, and to some extent, agriculture. The secondary data used in this study come from several case studies published in scientific works, and from various official and public handbooks, such as the Guide INSOLL (2017), the Cahiers Inmédiats (2014), and the Livre Blanc des LL (2014). Reports on several Living Labs (North America and Europe) were collected to enrich the previous data. Meetings with six experts helped to consolidate the results. The authors of this study also mobilized data from several Living Labs (Sensagri E2L and Brie'Nov) that they had already studied. Dumez (2013) mentions about this: "*To take into account the diversity of situations that it studies (. . . ), it emphasizes the concrete context of action and interactions*".

Furthermore, the long-term involvement of the researchers in the field of Living Labs positions them as both active participants and observers. This duality is at the heart of the scientific 'posture' and has shaped the understanding of the dynamics, processes, and issues inherent in the object of study (Jarzabkowski and al., 2013). The researchers responsible for this study have endeavored to maintain a critical and reflexive approach throughout their research, as required by this specific "posture".

Again, the researcher's extensive involvement in active Living Labs and various international networks, such as ENoLL, Réseau Francophone des Living Labs, International Association for Public Participation, and Décider Ensemble, has provided valuable data and experiences that have been crucial in formulating the scope and the methodologies of this research.

However, a rigorous approach has been adopted to collect and to analyze data to ensure objectivity and minimize biases that may arise from proximity to the object of study. Following Miles and Huberman's (2003) guidelines for data processing, data were cross-checked and grouped. The comments provided by Ozturk and al. (2024) on the bibliometric approach set by Walsh and Rower (2022) also helped to analyse the data generated through clustering. Despite the efforts of the authors of this study to follow the guidelines set forth by Walsh and Rowe (2022), some challenges were encountered, particularly when it came to defining boundaries and figures, as

recommended. Another challenge was the need to consider all data, to present a comprehensive and accurate picture of inclusion in LLs. The results of this qualitative exploratory research are presented in the form of conceptual proposals (Ibert and al., 1999).

# 4 Findings and interpretations

## 4.1 Notions of inclusion and forms of inclusion associated with Living Labs

### 4.1.1 About Knowledge inclusion

The notion of inclusion associated with the LL as an intermediary organization refers to several phenomena in the academic literature and does not seem to be -reasonably- related to the objects of the authors' research, nor to their scientific fields. From an empirical point of view, the notion of inclusion does not seem to be associated with the sectors of activity of the LLs studied here (health, rurality, agriculture).

Three specific representations of the phenomenon of inclusion in LLs emerge from the in-depth study of the literature and the feedback from the studies: knowledge inclusion, stakeholder inclusion, including users, and social inclusion.

The notion of knowledge inclusion seems to be part of a logic of operation specific to Living Labs, whose consensual conceptual definition is partly based on the existence of socially distributed knowledge, with reference to the work of Trépos 1996, as mentioned above. Knowledge is perceived here as both input, output and, also as a support for action and its inclusion is an integral part of the LL organization. For Tremblay, Cyr, Cohendet and Simon (2022), the LL is moreover similar to a set composed of "knowledge commons" supported by all interested communities. As a result, the inclusion of knowledge constitutes the core of this dynamic system dedicated to innovation that is the LL.

However, it is the inclusion of diverse knowledge that seems to be the crux of LLs, according to the work of many scholars including Ståhlbröst and Holst (2012), Almirall and al. (2014). Other LL scholars including the various partners in INSOLL (2017) also emphasize the need to include knowledge from different sources, in order for an LL to play its role as an open system that recombines knowledge to collectively produce a common artifact. Categories of knowledge identified in the literature reviewed for this study include scholarly and lay knowledge (Cuny, 2008), scientific, professional, experiential (Jouet and al. 2009) or activist knowledge. Lehmann, Dubé, and Frangioni (2015) identify these different types of knowledge located at the heart of an LL, building on the work of Nez (2014).

Other literature on LLs focuses on the processes of knowledge transfer, knowledge development, knowledge creation, or knowledge recombination, which would represent the inclusion of knowledge and the core of any "knowledge commons" (Tremblay and al., 2022). For Janin and Pecqueur (2017), LLs represent "intense knowledge communities", referring to the writings of Cohendet and Diani (2003). For the latter two authors, the inclusion of knowledge in an organization requires, among other things, the identification and understanding or recognition of the mechanisms associated with knowledge sharing.

From an empirical point of view, this notion of knowledge inclusion is also present and appears in several documentations related to active LLs. For example, the Quebec Living Lab AcadieLab describes itself as an organization characterized "by the pooling and sharing of knowledge between scientists and farmers" (website 2023).

### 4.1.2 Inclusion of multiple stakeholders

Regarding the phenomenon of multi-stakeholder inclusion in a LL, many authors dealing with this topic (e.g. Almirall, Wareham, 2011; Westerlund, Leminen, 2011) often emphasize the complexity of LLs as intermediary organizations, in relation to the need to actively involve a wide variety and heterogeneity of stakeholders, with different backgrounds, in terms of knowledge, roles, experience, age, language, gender, and so on. Malmberg and al. (2017, p. 12) point out on this topic: *"The Living Lab approach strives for mutually valued outcomes that are results of all stakeholders being actively engaged in the process from the very beginning".*

Furthermore, from a scientific point of view, it seems to be a given that the inclusion of the users of the (future) solutions jointly produced in the framework of a LL is a key point of any LL. Most of the recent academic texts come back to the importance of users as drivers of LL, based on the work of Von Hippel (1986), to mention only this author. For Almirall and al. (2012), Dubé and al. (2014), Leminen (2015), Ballon and Shuurman (2015) and Lehmann (2020), the very relevance of LL is at stake. Cognetti (2023, p. 27) mentions: "*Living Labs have a strong action orientation, as they help develop new products and services by engaging users with heterogeneous knowledge, ideas, and experiences. User' involvement indicates a shifting of innovation toward the community, thus cocreating with them*".

Practitioners agree. As a concrete example, the Living Lab of the National Cancer Centre (French) states bluntly on its website (visited in 2023): "*The LL focuses its actions on the development of solutions, tools for all stakeholders to help them better understand the pathways. The place of the patient and his inclusion in the definition of his solutions is essential and all transdisciplinary skills are called upon."*

Furthermore, in the academic, professional, and institutional literature on LLs, authors agree that the divergence of ideas between stakeholders engaged in an LL, including users, is a prerequisite and an asset for the co-construction of an innovation intended for widespread use (Lehmann, 2020). The divergence of ideas is one of the five principles of an LL, as outlined by Ståhlbröst and Holst (2012). who recognise the influence that stakeholders from diverse backgrounds can exert on the development of an LL (Nguyen and al., 2019).

It is interesting to note that studies of the phenomenon of stakeholder inclusion are typically embedded in a broader, more global reflection. This has led authors to say, for example, that it seems necessary to include stakeholders at an early stage of the organization of a LL (Malmberg and al., 2017) in order to be able to define common rules or that it is essential to "mix" stakeholders from different backgrounds during the numerous workshops or working sessions so that the different points of view are explored (Lehmann, Colomb, 2020).

The recent professional and academic literature has also examined the phenomenon of stakeholder inclusion through other lenses including those of: legitimacy, representativeness, involvement, management, and rewards, .... which should not be overlooked.

For his part, Ferdman (2017, p. 239) emphasizes the importance of recognizing the complexity of inclusion as a process and the need to consider different macro, meso, and micro processes and contexts, *"ranging from societal and organizational ideologies, values, policies and practices to leadership models and practices and group norms and climates"*.

### 4.1.3 Social inclusion

Considering the phenomenon of social inclusion within a LL, this notion of "social" reflects a strong interest in vulnerable, disadvantaged, or even discriminated stakeholders in certain cases and, also in stakeholders that are difficult to access or even those that are non-human, such as the species that make up the fauna or flora. The majority of studies that examine social inclusion

in LL explore the need, if not the requirement, to engage with vulnerable (or even non-human) stakeholders, to seek their voices, to collect their ideas, to experiment their proposals, to count their votes or at the very least their requirements, and so on, in a manner that is comparable to that of any other stakeholder involved in the Living Lab.

In the existing literature on social inclusion and LL, the work of Grasso and colleagues (2014) is noteworthy for its emphasis on the potential of LLs to serve as intermediary organizations within the social and solidarity innovation sector. This perspective underscores the importance of including those who would be the beneficiaries of the social innovation to be produced within the LL. The phenomenon of social inclusion in a LL is also explored in the literature on urban LLs (Broto, Westman, 2019) and health LLs (the M-Lab Mental Health Auvergne website, the official report of the LLSA Forum, 2015), where social inclusion in a LL is stated as an imperative.

On the other hand, innovations carry with them potential societal impacts, as mentioned by Ballon and Shuurman (2015). But bridging social gaps requires the development of inclusive processes that engage with audiences that are often marginalised for various psychological, social and economic reasons (Gupta and al., 2006).

For Van Geenhuizen (2018), Living Labs -*by definition*- create collaborative learning between users, producers, researchers, and other relevant stakeholders, including financial investors, local regulators and policymakers, citizen groups, and other interested parties within a broader network. They are key enablers of innovation processes and bridge the gap between public organizations and other innovation stakeholders, in particular citizens, and innovation intermediaries (Manzini, Staszowski, 2013). This allows public actors to transition from a conventional model of public innovation to a collaborative approach (Bekkers and al., 2013).

These various points lead back to the conceptual definition of the LL, which presents the LL as an organization whose mission is to provide common solutions to emerging and embedded needs, through a multi-stakeholder and collective construction of innovation. In other words, building an LL would mean enacting (or deploying) the fifth innovation helix proposed by Carayannis and al. (2012) which would necessitate a high degree of social inclusion

## 4.2 Contributions made by inclusion of various stakeholders and knowledge in a Living Lab

### 4.2.1. Success factor and value creator for the LL

In both the scientific and professional literature, the inclusion of diverse stakeholders in a LL is frequently identified as a success factor for a LL. According to Davis (2017), who analyzed the success of a LL by considering stakeholder dynamics, the inclusion of multiple stakeholders in a LL is undoubtedly a condition for a successful LL.

In accordance with the principles of open innovation (Chesbrough, 2003; Carayannis and al., 2012), it is imperative, if not indispensable, to include users, members of civil society, researchers, representatives from various governmental levels, and companies with a vested interest in a LL. As Lehmann (2020) asserts, the incorporation of stakeholders from a multitude of sources enables the development of an accepted, sustainable, and utilized artifact. Some scholars and practitioners have also identified the importance of including diverse perspectives as a core aspect of LLs (Ståhlbröst, Holst, 2012; Dubé et al., 2014; Davis, 2017). Nevertheless, the vast majority academic and professional literature indicates that the selection of stakeholders to be specifically included in an LL remains contextual and dependend on the mission of the LL, its environment, and its objectives.

Furthermore, the involvement of stakeholders can also generate value for the organizations that conduct a LL, rather than solely benefiting the LL itself, as illustrated by the research of Nyström

and colleagues. (2014). De Vita and De Vita (2021) investigated fourteen intra-organizational LLs and concluded that the input of stakeholders in the LLs resulted in value creation for the organizations in question. This included, for example, enhanced commercial acceptability of a service or product or increased visibility of the organization.

### 4.2.2. Individual and collective gains

For a significant number of researchers engaged in the study of LLs, the appropriate inclusion of stakeholders in LLs presents a pathway to a multitude of gains, extending beyond the success of the LL in terms of implemented innovation.

These gains are most often associated with the acquisition of new knowledge by the stakeholders involved, including knowledge about their own environment and the empowerment of these stakeholders (Veeckman, Van der Graaf, 2015; Cognetti, Maranghi, 2023). These benefits pertain to the individual and collective capacity to learn and decide, as postulated by Huang and Thomas (2021). They also relate to the individual appropriation of change, as put forth by Boni (2023). Additionally, they encompass the stimulation of pre-existing links or relationships and the creation of a network, as proposed by De Vita and De Vita (2021).

The notion that the inclusion of a heterogeneous group of stakeholders within an LL facilitates a constructive dialogue or stimulates interactions between these stakeholders following the collective generation of an innovation through the LL is a recurring topic in the literature. Accordingly, Wachter (2023) posits that collaborative and participatory planning has fostered constructive dialogue between institutional representatives and communities seeking to deploy forms of collaborative rationalities.

Participants who have had the opportunity to work with and build relationships with a range of stakeholders (end-users, businesses, researchers, etc.) are likely to view their experience in a positive light. In summary, the experience of participating in a Living Lab can be transformative, leaving a lasting impact on personal and professional development. It can also foster the formation of communities of practice (Wenger, 1998).

Regarding the psychosocial aspects of change, Boni (2018) confirms the importance of including a diverse range of stakeholders in LLs. "The values and advantages associated with Living Labs in terms of the effectiveness and appropriateness of the solutions identified.". For Hossain and al., (2019), the LL's role in addressing pernicious and complex problems collectively enhances the general well-being of a given population.

It is noteworthy that in certain instances, social inclusion represents both the objective of the LL, and a fundamental element of the LL. The idea put forth is that social inclusion within a LL facilitates a more robust inclusion of vulnerable stakeholders in their surrounding environment post-LL. Cognetti (2023, p. 10) and his colleagues, explore how a LL can engender "a more effective inclusion of inhabitants and local groups in urban policies". They cite as following: "*a process of co-design can contribute to social mobilization, expanding the range of devices and rituals that residents and their support networks can put into practice*." However, certain conditions must be met for this to occur, as Cognetti notes: "*Urban LLs become devices of inclusion if they are able to strengthen and improve local development and promote activities that are everyday, cultural, and plural*."

In their 2019 study, Fasshauer and Zadra-Veil posit that LLs serve as catalysts for the formation of long-term relationships, the establishment of democratic governance structures, and the creation of spaces that facilitate the consolidation and stabilisation of relationships. The knowledge, capitalisation of experimentation and relational engineering created enable collective learning.

## 4.3 Difficulties and Challenges of Inclusion in LLs

### 4.3.1. Many categories of knowledge to include

In terms of knowledge inclusion, the existing literature returns to the different types of knowledge that are present or should be present in an LL depending on the type of literature in question (i.e. descriptive or prescriptive).

Some authors point out that the knowledge may be "poorly integrated" due to potential flaws in the data retrieval processes, including insufficient development and formalisation, or lack of adaptation (Leminen, Westerlund, 2017). The multiplicity of stakeholders involved in LLs also presents a significant challenge in terms of knowledge collection and capitalisation, as highlighted by Dubé and al. (2014).

Those engaged in the field of LLs have observed that the incremental and iterative nature of the LL approach results in the mobilisation and generation of a substantial volume of knowledge, which can prove challenging to capture, compile, decipher or utilise (Lehmann, 2020).

Several studies have concentrated on the identification of explicit and tacit knowledge (Nonaka, Takeuchi, 1997) and its creation and transfer as part of a collective innovation process within a Living Lab (Hund and al., 2019; Alavi, Leidner, 2001). Tacit knowledge can be shared among group members and combined with other types of knowledge. Additionally, individuals may disseminate tacit knowledge directly through socialization (Alavi, Leidner, 2001). These different mechanisms for sharing knowledge, whether tacit or explicit, through socialization, externalization, combination, and internalization, play a pivotal role in the innovation process. These findings indicate that it is challenging to achieve a comprehensive inclusion of knowledge within an LL, even when efforts are made to include stakeholders. This point is significant because it pertains to the mechanisms of data collection and processing, rather than the issues of commitment, motivation, and retention of those involved in an LL.

### 4.3.2. Stakeholder inclusion is too rare and complex

A significant number of authors who have conducted research on Living Labs point out that stakeholder inclusion in a LL is rare and remains a struggle, despite the availability of tools and the advancement of technologies designed specifically for LLs, which have been developed with the intention of facilitating this inclusion.

Bylund and al. (2020) highlight that one of the main challenges in the development of urban LLs "is equity and inclusion". According to Veekman and al. (2013), a key challenge is to maintain the inclusion of stakeholders in an LL over time, so that the artefact developed and produced collectively by these stakeholders accurately reflects the diverse perspectives of those involved in the LL.

Despite the efforts of the United Nations since 1996 to promote the inclusion and recognition of vulnerable groups, Broto and Westman (2019, p. 73), in their recent book on urban LLs, point out that: "*Participation in decision-making processes, especially with regard to marginalized neighborhoods, is rare*," and "*not sufficient to enable the transformative intent of sustainability action because of imbalances in power, capabilities, and contexts.*"

Boni (2023, p. 64) identifies two key challenges to the inclusion of various actors. The first is the use of *"the most appropriate tools for recognizing roles and decision-making power within collaborative processes"* and the second is the difficulty *"to establish increasingly collaborative working practices that overcome competitive or political dynamics*." As Fasshauer and colleagues (2020) have observed, accurately including all stakeholders represents a significant challenge. This is related to the capacity of the LL of integrating users without instrumentalizing them, balancing the different powers of stakeholders, and establishing rules that facilitate co-creation.

Further challenges pertaining to the inclusion of stakeholders have been identified. Several scholars have underscored the significance of establishing a LL that permits free entry and exit of participants. Schuurman and his colleagues (2016) have identified that aspect as a crucial one for inclusion in a LL. Indeed, the openness of the LL has the potential to disrupt the process and functioning of the LL. As Ståhlbröst and Holst (2012) have mentioned, in this case, the loss of trust and the emergence of conflicts have the potential to culminate in the dissolution of any collaborative endeavour. Moreover, the possibility of individuals entering an LL who are unwilling to adhere to the values of that LL is identified as a significant factor contributing to the dissolution of the LL (Hakkarainen, Hyysalo, 2013; Van Geenhuizen, 2018).

It is also crucial to acknowledge that, in practice, the pursuit of inclusion can potentially exacerbate other organizational challenges, including those pertaining to stakeholder engagement (Torma, 2023), user participation (Compagnucci and al., 2021), and respect for diverse perspectives (Carrel, 2017). These challenges are particularly salient in the context of temporary organizations, such as LLs. The inclusion of stakeholders can also result in an increase in the complexity of these partnerships, as observed by Mok and colleagues (2017).

In addition, it would be a grave oversight to underestimate the issues raised by e-inclusion. This was explored by the Swiss ITC Commission in 2009 in the context of an LL on e-inclusion in society. Simitsek, a researcher involved in the project entitled "LL E-Inclusion," issued a cautionary statement: "E-*inclusion has a much broader dimension than that of exclusion from a technological good. It tends to become exclusion from society as a whole: exclusion from its participation, exclusion from its shaping, exclusion from its progress*"(p. 12) (e-Gov Präsenz from February 2010). In 2016, Voilmy will further develop these notions.

### 4.3.3. Stakeholder perceptions about inclusion

Finally, it remains important to note that even when inclusion is "successful" from the very point of view of stakeholders in LLs, their vision, satisfaction, and expectations towards the LLs in which they are active may vary.

In their study of the behaviour, relationships and narratives of stakeholders who were people with disabilities involved in LLs dedicated to projects addressing aspects of daily living and other projects aimed at improving the person's conditions for better social participation, Grasso and his colleagues (2014) found that "*people with disabilities are really open to all projects and underline as a priority requirement, whatever the project, the need to do something and the realism of the projects*" (p.167). Moreover, these stakeholders requested to be included in all phases of the various projects, should their inclusion prove relevant.

It is crucial to acknowledge that participants' perceptions of their contribution and the potential impact of the collaborative process are likely to be influenced by their understanding of the impact of their contributions on current projects. Those who perceive their participation in the Living Lab as an opportunity to acquire new skills, expand their professional networks, and develop personally are likely to hold a positive perception of their inclusion. This learning experience is not solely focused on the acquisition of new technical or professional skills; it also encompasses the development of interpersonal skills, an enhanced comprehension of group dynamics, and the acquisition of novel perspectives on issues of diversity and inclusion (Lehmann, Zadra-Veil, 2024). These latter findings suggest that inclusion, even when it can be considered to have been fully achieved, is merely one element of the overall perception of the individuals within a so called “inclusive” organization.

## 5 Conclusions

It should be noted that the findings presented above are the result of an exploratory, qualitative study. As such, it is not appropriate to extrapolate the findings cited and it is important to consider the interpretations as proposals, or even working hypotheses (for future studies). However, this does not prevent from defining several implications for research and practice (Gherardi, 2019).

The study presented here shows that practicing inclusion does not seem to be an option or a "nice to have" in the case of LLs, but that it is “not an easy journey”, to quote Williams Day: the operationalization of an LL requires the inclusion of knowledge and stakeholders, including users.

The findings suggest that the issue of inclusion in LLs should be addressed prior to the establishment of a LL. It should be defined in terms of three key areas: knowledge inclusion, stakeholder inclusion, and social inclusion. It may be pertinent to engage in debate regarding the potential for social inclusion to emerge as an outcome of the forthcoming LL. Conversely, there is a necessity to provide sustenance for any form of inclusion throughout the entirety of the LL's lifecycle.

The findings reveal that inclusion confers value upon LLs in a multitude of ways. It enhances their legitimacy as intermediary organizations; it delivers individual gain as appropriation and readiness for change or new knowledge acquisition; it also offers collective gains through the creation of social networks; finally, it facilitates stakeholder engagement, when managed properly.

The findings indicate that achieving inclusion is a challenging process, as there are numerous forms of inclusion to integrate, a lack of attention to this issue, and the presence of institutional obstacles. Additionally, the concept of "feeling included" is an important dimension to consider.

While inclusion in LLs may appear to be “natural”, it is nevertheless crucial to give the phenomenon due consideration before launching an LL. Those responsible for organising a LL should decide how to promote inclusion, which in this context means defining the tools and management practices that will make participants “feel included”. The evaluation of this perception could be readily measured throughout the entire lifecycle of a LL, using a variety of psycho-social metrics tools. Despite the fact this study does not focus on the organization of LLs, it appears that facilitators and organizers play a pivotal role for stakeholder inclusion. This pertains to the governance, regulations, configuration, and itinerary that need to be established upstream. It is also essential to be prepared to adapt these elements, given that the LL process is inherently iterative.

On the other hand, as far as social inclusion is concerned, it may be beneficial for LL sponsors and managers to consider integrating this dimension into the scope of their LLs, despite its apparent irrelevance at first glance. Many LLs that do have social inclusion as one of their objectives, such as agricultural or commercial LLs, will enhance their networks and gain value from the perspective of their stakeholders by incorporating social inclusion into their stated goals.

Moreover, considering the existing literature and the secondary data presented here, any LL that claims to be inclusive should provide a clear and explicit definition of what it means by this claim. This is regardless of whether it may appear to be a natural assumption that an LL should be inclusive, both in the eyes of stakeholders and the general public.

Concerning the relevant knowledge for LL inclusion, it seems obvious that the participatory methods and tools should be thoroughly familiar to the organizers and selected with precision. Those interested in organising inclusion in LLs should consider borrowing from the practices of knowledge management (Ruohslati, 2020), engagement (Correia Loureiro and al., 2020), participation (Ommen and al., 2016), and expectation management (Ferguson and al., 2017) to achieve this inclusion.

In their concluding remarks, Broto and Westland (2019) advocate for a more nuanced understanding of the role and position of conflict in the phenomenon of inclusion within LLs. The two researchers urge to do so as follows: "*Approaches to participation must (...) integrate conflict as a necessary component of inclusion and explicitly seek to remedy exclusions based on race, gender, migratory status or other sociocultural dimensions*"(p. 183).

With regards to participation, it is therefore important to recall that the terms 'consultation', 'involvement', 'collaboration' and 'empowerment' denote different methods for practicing stakeholder inclusion, which refer to different conceptualizations of collective action. As numerous studies point out, active engagement, appropriation, and change will be challenging to achieve when collaboration is ineffective (Lehmann, 2022). It is therefore crucial to give due consideration to these issues. The findings presented here also encourage Living Lab facilitators to act as "bridgers" to promote people with specific skills to sustain collaboration between LL members over the long term. (Curley, Salmelin, 2017).

## 5.1 Some practical implications

The findings of this exploratory study, which is primarily based on an extensive literature review and secondary data, suggest potential practical implications for hybrid and/or intermediary organizations.

Regarding knowledge for inclusion in LLs, it seems important for the LL managers to make some efforts to recognize that all participants must have a clear understanding of the data they are working with. This goes beyond mere access or translation and encompasses interpretation and empowerment. The sharing of knowledge, which is vital for inclusion as showed in the results, should align with the ability of stakeholders to easily manipulate objects, drawings, and ideas. The training of stakeholders should be sensitive, as it already is in some LL contexts.

In considering broader "practical" implications, education is worthy of particular attention. Some training is already provided for the organization of a LL. For instance, the ENOLL and the Université de Lille have developed a series of short programmes designed for project managers, administrators, elected representatives and active citizens.[1] Nevertheless, despite the incorporation of stakeholder participation, engagement, and involvement as a core component of the curriculum, there is a notable absence of dedicated training about stakeholder and knowledge inclusion. In light of the findings of this study, it may be beneficial to incorporate the topic of inclusion into the training programme. This could encompass a focus on stakeholder management, knowledge integration, social networking and capacity building for facilitation. Additionally, conflict management and diversity management could be incorporated into the core curriculum.

As the experts and the findings suggest, project managers who assume the roles of Living Lab organisers or coordinators should undergo training to become (better) adaptative facilitators and servant leaders (Nauman and al, 2022). They need to develop new soft skills, including those related to improvisation, collective decision-making, innovative participatory processes, and knowledge sharing, to fully embrace inclusion. This is already an issue in/for some university programmes, as evidenced by the case of Sciences Po Lyon in France or UQAM in Canada, where students engage in activities related to these concepts.

## 5.2 Some research implications

At first, it would be relevant to apply the study of inclusion outlined here to other hybrid and/or intermediary organizations, whether (or not) it is an exploratory study.

1. Further details may be found on the following websites: https://enoll.org/about-us/learning-lab/;https://ensembll.fr/nos-formations/formation-professionnelle/.

Further work could focus on injunctions to inclusion in LLs, drawing on of Carrel, 2016, who explored the phenomenon of the participatory injunction. Conversely, assessing the precise gains from inclusion in LLs could also be of interest and could lead to some new practical implications for LL *organizing*.

It would be certainly relevant to examine whether certain tools and methodologies currently employed may be more exclusionary than others. Furthermore, it would be beneficial to examine whether specific postures or attitudes of LL participants help to overcome certain physical, cognitive, cultural, and learning barriers. With reference to the work on intermediary organizations by Howells (2006) and Agogué and al. (2013), it would also make sense to study which postures - among those of matchmaker, facilitator, mediator, orchestrator, innovator - promote the phenomenon of inclusion in an LL.

One area of investigation should be the stakes and difficulties of inclusion in the context of the field of action of LLs as intermediary organizations, with a particular focus on the following areas: health, agriculture, education, social and territorial development. The challenges of inclusion may vary significantly from one field to another. Undoubtedly, it is important to identify the contexts that may favour inclusion. It would be also interesting to conduct a study to ascertain which of the four categories of LL, as described by Leminen (2015), experience greater challenges with inclusion or facilitate it.

Following the suggestions of Fava (2023), a research project on inclusion within an organization that claims to be or aspires to be inclusive would undoubtedly be a valuable contribution to the field of organization theory. In the article "Beyond the Presence: Dwelling with People and with Their Places", Fava calls for a more nuanced understanding of inclusion in urban LLs, moving beyond the study of mere "presence" of included actors.

Moreover, it should be noted that e-inclusion (Simitsek, 2009) remains a poorly understood research object, even if current trends suggest that e-participation is gaining ground in the context of LLs, as evidenced by the findings of the European Network of Living Labs (ENoLL) in 2023.

Obviously, this exploratory research could be enriched, enlarged, and expanded in order to improve and consolidate the current findings and suggestions.

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## 6 References


Acker, J. (2006). Inequality Regimes: Gender, Class, and Race in Organizations. *Gender and Society, 20*(4), 441–64.

Adamson, M., Kelan, E., Lewis, P. Sliwa, M. & N. Rumens (2021). Critically interrogating inclusion in organizations. *Organization, 28*(2) 211– 227

Aernouts, N., Cognetti F & E Maranghi (Eds) (2023). *Urban Living Lab for Local Regeneration, Beyond Participation in Large-scale Social Housing Estates*, Springer.

Agogué, M., Yström, A., & Le Masson, P. (2013). Rethinking the role of intermediaries as an architect of collective exploration and creation of knowledge in open innovation. *International Journal of Innovation Management, 17*(02), 1350007.

Akasaka, F., Mitake, Y., Watanabe, K. and Y. Shimomura (2022) "A framework for configuring participation in Living Labs", *Design Science*, Cambridge University Press, 21 pages, https://doi.org/10.1017/dsj.2022.22

Alavi, M., & Leidner, D.E. (2001). Review: Knowledge Management and Knowledge Management Systems: Conceptual Foundations and Research Issues. *Management Information Systems Quarterly.*, 25, 107-136.

Almirall, E., M. Lee & Wareham, J. (2012). Mapping Living Labs in the Landscape of Innovation Methodologies. *Technology Innovation Management Review*. Sept, 12-18.

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

Anquetil S. (2013). *Représentation et traitement des actes de langage indirects*, Domaines linguistiques, Série Formes discursives, Paris, Classiques Garnier.

Arnstein, S. (1969). Une échelle de participation citoyenne, *Journal of the American Planning Association, 35*(4), 216-224.

Austin J. L. (1962), *How to do things with Words*, Cambridge, Massachusetts, Harvard UP.

Autissier, D., Madoun, M. & J-M, Peretti. (2019). *Transformer sans rompre ni exclure : étonnante actualité de l'Inde ancienne*. Editions EMS France

Autissier, D. & J-M. Moutot, (2017). *La boîte à outils de la conduite du changement*, Editions Dunod, France

Ballon, P., Schuurman, D., (2015). Living labs: concepts, tools and cases, *Info*, Vol. 17 (4)

Barnard, C.I. (1938). *The Functions of the Executive*, Thirtieth Anniversary Cambridge, MA: Harvard University Press .

Beauchamp, R., Heidari-Robinson, S & S. Heywood. (2016). Reorganizations without tears. *McKinsey Quarterly*, October, 6 pages

Bekkers, V. J. J. M., Tummers, L. G., & Voorberg, W. H. (2013). From public innovation to social innovation in the public sector: A literature review of relevant drivers and barriers. Paper presented at the *EGPA 2013 Conference*. Edinburgh, September 11–13.

Berthou, V. & R. Picard (2017). Les Living Labs, ces leviers d'innovation en santé publique, F.F.E. « Annales des Mines - Réalités industrielles » 2, 68-72.

Boni, A. S. (2023). Urban Living Labs: Insights for Institutionally Promoted Urban Policies. In *Urban Living Lab for Local Regeneration, Beyond Participation in Large-scale Social Housing Estates*, by Aernouts, N, Cognetti F & E Maranghi (Editors), Springer, Chapter 4, 53- 68.

Broto V. C. & L. Westman, (2019). *Urban Sustainability and Justice*. Bloomsbury Academic

Bylund J, Riegler J & Wrangsten C (2020). Are urban Living Labs the new normal in co-creating places? In: *C3Places, culture & territory,* Smaniotto C, Menezes M, Maciuliene M, Romeris M, & Golicnik Marušic B (eds) Lusófona University Press, 4, 7-21.

Collectif dirigé par Amourous, T. (2014). *Living Lab, une nouvelle forme de rapport au public*. 3, Cahiers Inmédiats 24 pages.

Carayannis, E.G., Barth, T.D. & Campbell, D.F., (2012). The Quintuple Helix innovation model: global warming as a challenge and driver for innovation. *Journal of Innovation and Entrepreneurship, 1*(1), 41-69.

Carontini E. (1984). *L'action du signe*. Louvain-La-Neuve, Belgium, Cabay

Carrel, M. (2017). Injonction participative ou empowerment ? Les enjeux de la participation. *ERES Vie sociale, 3*(19), 27-34.

Chesbrough, H. (2003). The Era of Open Innovation. *MIT Sloan Management Review*. Spring 2003, USA, 44 (3), 78-89.

Cognetti F (2023). Beyond a Buzzword: Situated Participation Through Socially Oriented Urban Living Labs. In *Urban Living Lab for Local Regeneration, Beyond Participation in Large-scale Social Housing Estates*, by Aernouts, N, Cognetti F & E Maranghi (Editors), Springer, 19-38.

Cognetti F & Maranghi E. (2023). Adapting the Living Lab Methodology: The Prefix 'Co' as an Empowerment Tool for Urban Regeneration in Large-Scale Social-Housing Estates. In *Urban Living Lab for Local Regeneration, Beyond Participation in Large-scale Social Housing Estates*, by Aernouts, N , Cognetti F & E Maranghi (Editors), Springer, 69-82.

Cohendet, P., & Diani, M. (2003). L'organisation comme une communauté de communautés croyances collectives et culture d'entreprise. *Revue d'économie politique, 113*(5), 697-720.

Compagnucci, L, Spigarelli, F, Coehlo, J & C. Duarte (2021). Living Lab and User engagement for innovation and sustainability. *Journal of Cleaner Production, 289*, 125721.

Correia Loureiro, S., M., Romero, J & R. Godinho Bilro (2020). Stakeholder engagement in co-creation processes for innovation: A systematic literature review and case study. *Journal of Business Research, 119*, 388-409.

Cuny, C. (2008). Figures et savoirs du "profane" dans un secteur de grands ensembles de l'est de Berlin. In *Le profane en politique. Compétences et engagements du citoyen*, by L. Bondiaux, Paris, L'Harmattan, 237-261.

Curley, M., & Salmelin, B. (2017). Open innovation 2.0: the new mode of digital innovation for prosperity and sustainability. Springer.

Davis, K. (2017). An empirical investigation into different stakeholder groups perception of project success. *International Journal of Project Management, 35*, 604-617.

Del Vecchio, P., Elia, G., Ndou, V., Secundo, G., & Specchia, F. (2017). Living lab as an approach to activate dynamic innovation ecosystems and networks: An empirical study. *International Journal of Innovation and Technology Management, 14*(05), 1705-1723.

De Vita, K., De Vita, R. (2021). Expect the Unexpected: Investigating co-creation projects in a Living Lab. *Technology Innovation Management, 11*(9/10), 6-20.

Dobusch, L. (2014). How Exclusive are Inclusive Organizations? Equality, *Diversity, and Inclusion: An International Journal, 33* (3): 220–34.

Dubé, P., J. Sarrailh, C. Billebaud, C. Grillet, V. Zingraff & I. Kostecki. (2014). *Le livre Blanc des Living Labs*. Umvelt Service Design, Montréal, Canada.

Dumez, H. (2013). Qu'est-ce que la recherche qualitative ? Problèmes épistémologiques, méthodologiques et de théorisation, *Annales des Mines - Gérer et comprendre* 2 (112), 29-42.

Dumez, H. (2016). *Méthodologie de la recherche qualitative : Les questions clés de la démarche compréhensive*. Paris, France, Vuibert.

Fasshauer, I. & Zadra-Veil, C. (2019). Le Living Lab, un intermédiaire d'innovation ouverte pour les territoires ruraux ou péri-urbains ? *Innovations*, I78-XXVI.

Fasshauer I., Fragny B. & Zadra-Veil C., (2020). Les Living Labs à la recherche de l'exemplarité démocratique. In *L'exemplarité dans l'économie sociale et solidaire : Initiatives inspirantes et modèles novateurs*., dir. by M. Combes-Joret & L. Lethielleux. EPURE-Editions et Presses Universitaires de Reims, 135-156.

Fava, F (2023). Beyond the Presence: Dwelling with People and with Their Places. In *Urban Living Lab for Local Regeneration, Beyond Participation in Large-scale Social Housing Estates*, by Aernouts, N, Cognetti F & E Maranghi (Editors), Springer, 85-98.

Ferdman, B. M. (2014). The Practice of Inclusion in Diverse Organizations, in *Diversity at Work: The Practice of Inclusion*, 3–54. San Francisco, CA: Jossey-Bass Inc.

Ferguson, L, Chan S., Santelmann, M. & B. Tilt (2017). Exploring participant motivations and expectations in a researcher-stakeholder engagement process: Willamette Water 2100, *Landscape and Urban Planning, 157*, 447-456

Frangioni, M., Abrassard, C., Bouchard, F., Dufour, J-M., Lehmann, V., Trépanier, M., Tremblay, D-G. (2016). *Je fais MTL : Rapport sur l'indice de mesure d'impact socioéconomique*, Ville de Montréal, 56 pages

Van Geenhuizen, M. (2018). A framework for the evaluation of Living Labs as boundary spanners in innovation. *Environment and Planning C: Politics and Space, 36*(7), 1280-1298.

Georges, A, Schuurman D., Baccarne, B & L. Coorevits , (2015). User engagement in Living Lab field trials. *Information, 17*(4), 26-39.

Gherardi, S. (2019). Practice as a collective and knowledgeable doing. Universität Siegen, Medien der Kooperation, Paper Series 8, 17 pages

Glew, D-J., O'Leary-Kelly, A-M., Griffin, R-W. (1995). "Participation in organizations: A preview of the issues and proposed framework for future analysis", *Journal of Management*, Vol 21, Issue 3, 395-421.

Grasso F, Desjardins M, Labbé D, Barbic S & E Kehayia (2014). Opérationnaliser l'inclusion dans les projets innovants. L'expérience du « MALL » à l'aune de la classification internationale du fonctionnement. In ALTER, *European Journal of Disability Research* , 8, 158–169.

Gupta A.K., Smith KG & Shalley CE. (2006). The interplay between exploration and exploitation. *The Academy of Management Journal, 49*(4): 693–706.

Hakkarainen, L., & Hyysalo, S. (2013). How do we keep the living laboratory alive? Learning and conflicts in Living Lab collaboration. *Technology Innovation Management Review*, 3 (12), 16-22.

Henry, G, Guyon, T., Martell, Y., Verstichel, P., Goffi, D., Vigneron, L. (2021). *Les marqueurs Living Lab*, Documentation professionnelle éditée par Institut Godin, WeLL, MVA et Smart Lab Belgique, 32 pages

Hossain, M., Leminen, S; & M. Westerlund (2019). A systematic review of Living Lab literature. *Journal of Cleaner Production*. 213, 976-988

Howell J. (2006). Intermediation and the role of intermediaries in innovation, *Research Policy* Vol 35 (5), 715–728

Huang, J.H., & Thomas, E. (2021). A Review of Living Lab Research and Methods for User Involvement. *Technology Innovation Management Review*, 11 (9/10), 88-107.

Hund, A., Holotiuk, F., Wagner & H-T., Beimborn, D., (2019). Knowledge management in the digital era: how digtial innovation labs facilitate knowledge recombination. In Proceedings of the 27th European Conference on Information Systems (ECIS), Stockholm & Uppsala, Sweden, June 8-14, 2019. ISBN 978-1-7336325-0-8 Research Papers. https://aisel.aisnet.org/ecis2019_rp/149

Ibert, J., Baumard, P., Donada, C., & Xuereb, J. M. (1999). La collecte des données et la gestion de leurs sources. *Méthodologie de la recherche en gestion*, 224-256.

INSOLL (2017). *Guide des bonnes pratiques du Living Lab*, rédigé par le groupe de recherche Innovation Sociale par le Living Lab, dirigé par Catherine Fallon (Spiral-ULg), Claire Lobet-Maris et Benoît Michaux (CRIDS-UNamur), 15 pages, Edité par Région Wallonie, Belgique ; Rapport de recherche 87 pages, at e https://orbi.uliege.be/bitstream/2268/217394/1/INSOLL%20

Janin, C & B. Pecqueur (2017). Les Living Labs : remise en question des processus de mise en marché et de politique publique, *Revue canadienne des sciences régionales, 40*(1), 5-11.

Jarzabkowski, P., Spee, A. P., & Smets, M. (2013). Material artifacts: Practices for doing strategy with 'stuff'. *European management journal, 31*(1), 41-54.

Klerkx L. & C. Leeuwis, (2008). Matching demand and supply in the agricultural knowledge infrastructure: experiences with innovation intermediaries. *Food Policy, 33*(3), 260-276.

Lehmann, V., Frangioni, M. & P. Dubé, (2015). Living Lab as knowledge system: A actual approach for managing urban service projects ?, *Journal of Knowledge Management*, 19 (5), 147-178.

Lehmann, V. (2017). Changing behaviours when dealing with climate risks: From Nudge to Living Lab, in *Weather and Climate Communication*, dir. by Motulsky, Guindon and Tanguay Hébert, PUQ, Chapter 13, 139-157.

Lehmann, V. (2020). Fondements et représentations de l'innovation collective, in *L'innovation collective, quand créer avec devient essentiel*, dir. by V. Lehmann & V. Colomb), Presses de l'Université du Québec, 1-28.

Lehmann, V. & V. Colomb (2020). *L'innovation collective, quand créer avec devient essentiel*, (dir.), Presses de l'Université du Québec, Canada, 268 pages.

Lehmann, V. (2022). L'avènement des parties prenantes contributrices aux projets, in *Pour des parties prenantes engagées dans les projets, réflexions théoriques et pratiques*. dir. by S. Boivin, C. Leyrie & P. Boigey, Presses de l'Université du Québec, Chapitre 1, 1-17.

Lehmann, V. & C. Zadra-Veil (2024), Living Lab , in *Démarches groupales : (re)penser l'articulation entre théories et pratiques,* dir. by C. Denève & H. Cléty, Editions Dunod, Chapitre 10, book in press.

Leminen, S & M. Westerlund (2019). Living labs: From scattered initiatives to a global movement. *Creativity, Innovation and Management, 28*(2), 250–264.

Leminen, S & M. Westerlund (2017). Categorization of innovation tools in Living Labs, *Technology Innovation Management Review*, 7 (1), 15-25.

Leminen, S. (2015). What are Living Labs ? Q & A. *Technology Innovation Management Review, 5*(9), 29-35.

Lirio, P., Lee, M. D., Williams, M. L., Haugen, L. K., & Kossek, E. E. (2008). The inclusion challenge with reduced-load professionals: The role of the manager. *Human Resource Management: Published in Cooperation with the School of Business Administration, The University of Michigan and in alliance with the Society of Human Resources Management, 47*(3), 443-461.

Malmberg K, Vaittinen I, Evans P, Schuurman D, Ståhlbröst A, Vervoort K (2017). Living Lab methodology handbook. Zenodo.

Manzini, E. & Staszowski, E. (2013). *Public and collaborative. Exploring the intersection of design, social innovation and public policy* (DESIS Network).

March, J-G. and H-A., Simon. (1958). *Organizations,* John Wiley and Sons, New-York

Miles, M.B. & Huberman, A.M. (2003). *L'analyse des données qualitatives*. Belgique, Éditions De Boeck.

Mok, K. Y., Shen G.Q., & R. J. Yang. (2017). Addressing stakeholder complexity and major pitfalls in large cultural building projects, *Construction Projects, 35* 463-478.

Mol, A. (2010). Actor-Network Theory: sensitive terms and enduring tensions. *Kölner Zeitschrift für Soziologie und Sozialpsychologie. Sonderheft, 50*, 253-269.

Nauman, S., Bhatti, S. H., Imam, H., & Khan, M. S. (2022). How Servant Leadership Drives Project Team Performance Through Collaborative Culture and Knowledge Sharing. *Project Management Journal*, *53* (1), 17-32

Nez, H. (2015). *Urbanisme : la parole citoyenne*. Éditions Le bord de l'eau, France.

Nguyen, H. T., Marques, P., & Benneworth, P. (2022). Living labs: Challenging and changing the smart city power relations? Technological Forecasting and Social Change, 183, 121866.

Niitamo, V.P. (2006). State-of-the-art & Good Practice in the Field of Living Labs. In Proceedings of the *2006, IEEE International Technology Management Conference* (ICE): 1-8.

Nonaka, I., & Takeuchi, H. (1997). *La connaissance créatrice : la dynamique de l'entreprise apprenante.* De Boeck Supérieur.

Nyström, A.G. & al. (2014). Actor Roles and Role Patterns Influencing Innovation in Living Labs. *Industrial Marketing Management, 43*(3), 483-495.

Ommen, N. O., Markus Blut, M., Backhaus, C & D. M. Woisetschläger (2016). Toward a better understanding of stakeholder participation in the service innovation process: More than one path to success, *Journal of Business Research*, Vol 69, 2409-2416.

Ortlieb, R. & Sieben, B. (2014). The Making of Inclusion as Structuration: Empirical Evidence of a Multinational Company, *Equality, Diversity, and Inclusion: An international Journal* 33 (3): 235–248.

Özbilgin, M. (2009). Equality, Diversity and Inclusion at Work: Yesterday, Today and Tomorrow, in M. Özbilgin (ed.) *Equality, Diversity and Inclusion at Work*. A Research Companion, Cheltenham and Northampton, MA: Edward Elgar. 1–16.

Öztürk, O. Kocaman, R., Kanbach, D.K.(2024), "How to design bibliometric research: an overview and a framework proposal", *Review of Managerial Science,* 1-29. https://doi.org/10.1007/s11846-024-00738-0

Poncet, J. (2010). Les intermédiaires en grande hydraulique. Le cas du périmètre irrigué du Gharb, Maroc. ISDA 2010, Jun 2010, Montpellier, France, 14 pages.

Ramsay, H. (2005). *Participation and Democracy at Work, Essays in Honour of Harvie Ramsay*, McMillan Education UK

Ruoslahti, H. (2020). Complexity in project co-creation of knowledge for innovation. *Journal of Knowledge and Innovation, 5*, 228-235.

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.

Schuurman, D. (2015). *Bridging the Gap between Open and User Innovation? Exploring the Value of Living Labs as means to Structure User Contribution and Manage Distributed Innovation.* Doctoral Dissertation. Ghent University. Brussels, Belgium.

Shore, L. M., Cleveland, J. N. & Sanchez, D. (2018). Inclusive Workplaces: A Review and Model, *Human Resource Management Review, 28*(2): 176–189.

Simitsek, I. M. (2009). L'E-Participation indissociable de l'E-Inclusion: Living Labs, une démarche intégrante, Rapport du projet Living Lab E-Inclusion, sponsored by La commission ICT de l'Académie Suisse des Sciences Techniques , 2 pages + 12pages ;

Steen, K. & and E. van Bueren (2017). The Defining Characteristics of Urban Living Labs. *Technology Innovation Management Review, 7*(7), 21-33.

Ståhlbröst, A. & Holst, M. (2012). *The Living Lab methodology handbook*, social informatics at Luleå University of Technology and CDT—Centre for Distance-spanning Technology.

Tashakkori A & C. Teedlie, (2003). *Handbook of mixed methods in social and behavioral research*, Thousand Oaks, Sage.

Taylor, J. (1989) *Une organization n'est qu'un tissu de communication*, Presses de l'Université de Montréal, Canada

Tremblay, N., Cyr, G., Cohendet P. & L. Simon (2022). La dynamique des communs de connaissances : le rôle d'un LL comme intermédiaire d'innovation ouverte dans le système de santé, *Revue Finance Contrôle et Stratégie*, (NS-12).

Trehorel, Y. (2007). *Mettez du changement dans vos projets! ,* Edition AFITEP

Torma, V. (2023). *Analysing stakeholder engagement: stakeholder involvement in urban living labs and the main processes needed to establish a living laboratory* (Doctoral dissertation, Anglia Ruskin Research Online (ARRO)).

Trepos, J-Y. (1996). Connaissance distribuée, formes de coordination et transaction sociale le cas de l'expertise. *Environnement & Société, 17*, 73-84.

Tsoukas, H. & Chia, R. (2002). An organizational becoming: Rethinking organizational change *Organization Science, 13*(5), 567–582.

Voilmy, D. (2016). Les Living Labs et la conception participative : l'exemple d'Activageing - Caisse nationale d'assurance vieillesse, *Retraite et société, 3*(75), 125-136.

Von Hippel, E. (1986). Lead users: a source of novel product concepts. *Management science, 32*(7), 791-805.

Von Hippel, E. (2006). *Democratizing innovation,* the MIT Press.

Veeckman C & S. Van der Graaf (2015). The City as Living Laboratory: Empowering Citizens with the Citadel Toolkit, *Technology Innovation Management Review, 5*(3), 78-92.

Wachter, S. (2023). Governing with urban Living Labs. In *Urban Living Lab for Local Regeneration, Beyond Participation in Large-scale Social Housing Estates*, by Aernouts, N, Cognetti F & E Maranghi (Editors), Springer, Chapter 3, 39-52.

Walsh, I., & Taupin, B. (2018). Une analyse bibliométrique de la recherche en gestion. *Revue française de gestion, 270*(1), 17-46.

Walsh, I., et Rowe, F. (2022). "BIBGT: combining bibliometrics and grounded theory to conduct a literature review". *European Journal of Information Systems*, Vol 32 (2), 1-22.

Wenger E., (1998). *Communities of Practice: Learning, Meaning, and Identity. Cambridge*, Cambridge university press.

Westerlund, M., & Leminen, S. (2011). Managing the challenges of becoming an open innovation company: experiences from Living Labs. *Technology Innovation Management Review, 1*(1).

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