

# How does the space influence Living Labs? Evidence from two automotive experiences

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**Living Labs (LLs) are defined as innovation ecosystems that integrate research and innovation processes in a real-life setting, in a logic of open–user innovation. Alongside the openness and user involvement, the real-life setting is seen as the third key element in which LLs are rooted and it defines the space where the innovation process takes place. However, so far little attention has been given to whether and how space influences LLs. Hence, borrowing the concept of Enabler Spaces as multidimensional containers fostering innovation processes, the aim of this paper is to improve the theoretical conceptualization of the real-life setting dimension of LLs. To do this, the paper will investigate how the physical, social, and organizational spatial dimensions interrelate with and influence the other two elements characterizing LLs, ultimately shaping their governance. In doing so, two case studies of LLs focusing on new forms of mobility grounded in two different (open and closed) physical spaces will be analyzed. Results offer arguments for further investigation into the relationships between the real-life setting of LLs based on physical spaces and the social and organizational dimension of the innovation space.**

## 1. Introduction

Having arisen at the end of the twentieth century, Living Labs (LLs) represent a recent phenomenon that has enjoyed growing interest on the part of academics and policymakers alike (Hossain et al., 2019; Greve et al., 2020). LLs are ‘user-centred open innovation ecosystems based on a systematic user co-creation approach, integrating research and innovation processes in real-life communities and settings’ (European Network of Living Labs, 2021). Thus far, scholars have focused mainly on the definitions and categorizations of LLs (e.g., Greve et al., 2020; Leminen et al., 2021), the roles and

degrees of involvement of end users (e.g., Almirall et al., 2012; Leminen et al., 2014, 2015a), the networks operating within LLs (e.g., Leminen et al., 2012, 2015b; Nyström et al., 2014), and how the co-creation approach directly involves users and other stakeholders in any step of the innovation process (Guzman et al., 2013). Among constitutive concepts of LLs, the emphasis has mainly been on openness and user engagement, while little attention has been paid to their real-life setting element and how it influences openness and user involvement (Hossain et al., 2019). Analysis of the real-life setting and, hence, the space where LLs are embedded, can certainly be worthwhile if we are to gain a deeper insight into the

relationships between actors, user involvement and the governance models deriving therefrom.

In an attempt to bridge this gap, this paper borrows from the literature on Enabling Space (ES), defined as a space supporting and facilitating innovation processes (Peschl and Fundneider, 2012). ES is designed as multidimensional and is formed by spatial sub-dimensions functional to foster innovation processes. Specifically, this paper investigates whether and how spatial sub-dimensions interrelate and influence each other, shaping the configuration of LLs in terms of openness, user involvement and the governance models ultimately arising from the relationships between participants. It further focuses on a specific kind of LL where testing of innovation technologies related to new forms of mobility. With the additional purpose of offering more evidence on a still understudied topic (Paskaleva and Cooper, 2021), the paper compares two different automotive LLs: the Modena Automotive Smart Area (MASA) and the Joint Research Centre Living Lab (JRC-LL), both located in Italy and both experimenting Autonomous and Connected Vehicle (ACV) technologies. ACVs are one of the fundamental upcoming disruptors in the mobility sector (Kaur and Rampersad, 2018) and involve a complex multifaceted set of technological and social aspects to be tested on physical roads, such as the interaction with people and obstacles entrenched in the surrounding urban environment. LLs can thus be beneficial tools. On the one hand, they can test ACVs, enabling a contextual and multidisciplinary analysis of technologies within a real space, foreseeing possible consequences and long-term effects and structural changes deriving from such a complex technology. On the other, they can analyze the interaction with end users and assess future technological diffusion. For the purpose of this paper, the focus shall be on three spatial dimensions – physical, social, and organizational (Peschl and Fundneider, 2012) – of ESs emerging as crucial for the analysis of the real-life setting of LLs when testing automotive innovation technologies.

The paper proceeds as follows. Section 2 presents the theoretical framework, while methodology is outlined in Section 3. The results and discussion thereof are presented in Sections 4 and 5 and, finally, conclusions are drawn, along with implications and limitations, in Section 6.

## 2. Living Labs as enabler spaces

Openness, user involvement, and real-life setting are the key elements defining LLs (European Network of Living Labs, 2021). The openness element has

been related to the Open Innovation (OI) theory (Bergvall-Kåreborn et al., 2009; Enkel et al., 2020). Scholars emphasize the open nature of the networks established by different actors working together in the formation of LLs and in innovation processes in a real-setting environment (Leminen et al., 2012; Nyström et al., 2014; Leminen et al., 2015b; Schuurman et al., 2016; Leminen et al., 2020). However, in LLs the openness element goes beyond the pure OI paradigm (Bergvall-Kåreborn et al., 2009; Leminen et al., 2015b), as it also reflects the multidisciplinary nature of the LL itself. This is on the condition that – within a collaborative framework – actors from various backgrounds holding different viewpoints need to be involved in the innovation processes. The user involvement element of LLs has been conceptualized within the User Innovation (UI) framework (Von Hippel, 1976, 2007), to comprehend how and why users might become co-creators and be actively involved in the technological innovation process (Eriksson et al., 2005; Edvardsson et al., 2012; Edwards-Schachter et al., 2012; De Silva and Wright, 2019). Unlike other UI approaches, such as Lead Users (Von Hippel, 2007) and Crowdsourcing (Howe, 2008), LLs allow end users to participate in all stages of the innovation process (Bergvall-Kåreborn et al., 2009) as creative consumers (Leminen et al., 2014) who act as innovators even without the direct participation of an innovating company or other entity investing intentionally in a co-creation process (Leminen et al., 2015a; Greve et al., 2020).

Hitherto, the LL as a realistic, natural, real-life setting has been relatively undertheorized, despite the complementarity relationship of the three constitutive elements (openness, user involvement, and real-life setting) and the increasing relevance that naturalness and realism of the innovation processes may have in a LL targeted at a specific technological field. Indeed, the creation of a real-life environment is affected by and in turn influences an LL's ability to involve users and be open to a variety of stakeholders who can offer different perspectives and contributions to the innovation process. Although, little attention has been devoted to investigating the spatial dimensions within which LLs are established; an exception is the contribution of Bergvall-Kåreborn et al. (2009), who argue that the constitutive elements of LLs – referred to by the authors as openness, influence, and realism – transform places into spaces. Here, the former are associated with a sense of similarity and objectivity, while the latter are concomitant with a sense of uniqueness and subjectivity due to stakeholder involvement, the methods chosen and the facilitation of activities.

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However, this paper does not emphasize the differences between spaces and places. Rather, it focuses on the spatial dimension as the constitutive element of real-life setting and on how it influences and relates to the openness and user involvement elements. The spatial dimension of LLs is undeniably of pivotal importance. As LLs aim to substitute the experimental and controlled approach of a traditional lab with a real-life setting, their spatial conditions are likely to foster or hinder collaboration among the stakeholders involved (Bergvall-Kåreborn et al., 2009). Additionally, as LLs aim to test technological innovations within a natural user environment (Ballon et al., 2005), spatial conditions play a key role in recreating the setting for realistic user involvement (Bergvall-Kåreborn and Ståhlbröst, 2009). Consequently, examining the space of the LL would facilitate more in-depth analysis of its openness and user involvement and ultimately deduce its governance model. Indeed, as open innovation networks (Leminen et al., 2012, 2020), LLs are based on a number of relationships between the actors involved, one that can be organized into different models of network governance (Provan and Kenis, 2007). On the one hand, there is the *shared participant governed network*, characterized by the involvement and commitment of all participants (or a significant subset

thereof) in the network, the symmetrical distribution of decision-making power, and the lack of a distinct and formal administrative entity. On the other hand, there is the *lead organization governed network*, where all major decisions are coordinated through and by a single participating member acting as leader and providing administration for the network and/or facilitating the activities of other members.

In order to improve the theoretical conceptualization of the real-life setting dimension of LLs, it is possible to borrow from the concept of ESs, defined as spaces ‘supporting, enabling and facilitating processes of innovation and knowledge creation’ (Peschl and Fundneider, 2012, p. 48). Specifically, Peschl and Fundneider (2012) define ESs as multifaceted and composed of a set of sub-dimensions, allowing for the emergence of innovation processes and favoring the spread of radically new innovation. Rooted in the concept of *ba* (Nonaka and Konno, 1998), and defined as a space where participants share their perceptions of reality and create new meanings through interactions, ESs are therefore multidimensional by definition, as exhibited in Table 1 (Peschl and Fundneider, 2012, 2014).

Because they appropriately encompass the characteristic elements of LLs, physical, social, and organizational spaces have been chosen to analyze the

**Table 1.** Enabling spaces – dimensions

ESs – dimensions	Description
Physical	The physical space in which the innovation and knowledge processes take place. It is a physical environment intentionally designed and built that surrounds the users with its concrete physical structure(s). Examples include offices, spaces for creative and knowledge gathering work, houses, urban places or urban settlements
Social	The social interaction occurring within the space for innovation and knowledge creation. The authors highlight how trust and openness are key enablers for the social dimension and need to be established before any kind of innovation work can start. That is why it is essential to spend considerable energy in selecting the ‘right’ members of an ‘innovation team’ and to attain a socially as well as functionally well-balanced group
Cognitive	The individual cognitive processes that foster innovation through observation, listening, and reflection on one’s presumptions
Emotional	Pointing out that cognition is always embedded in emotional states, the authors stress how this dimension offers features that trigger such states, supporting processes of innovation and knowledge creation
Epistemological	The epistemological space refers to the creation of an enabling environment in which knowledge dynamics can develop, thrive, and flow
Organizational/cultural	Innovation is always embedded in the culture and organizational structures of an organization. The structures (such as hierarchy, departmental make-up, interaction patterns, communication culture) are often transformed by innovation processes, implying a more or less radical change in the organizational culture
Technological	The technological space refers from low- to high-tech tools such as computers, the internet and social media, in which innovation processes are at all times embedded
Virtual	Innovation does not necessarily always have to take place in a face-to-face setting, as much of the work can be done in the virtual dimension. Hence, virtual tools enabling these processes may support observation, prototyping, simulating, and so forth

Source: Authors’ summation based on Peschl and Fundneider (2012, 2014).

real-life element in LLs with the aim of testing technological development and its interaction with users within a complex network of actors and in an urban or urban-like environment. The physical space represents the concrete and real environment that surrounds users when they are engaged in the innovation process, and is of crucial importance in characterizing the real-life setting of a LL. For example, if a new technology encompassed in a product is to be observed in its interaction with, or when being experimented by, users, the physical space is called upon to reproduce as best as possible the real environment that usually surrounds the action of users when they operate that kind of technology. Based on the characteristics of its physical space, LL should be designed in order to provide an open setting that allows all the relevant actors to work together and users to be effectively involved (Dowling and McGuirk, 2020). Thus, physical structures shaping the real-life setting of LLs (Veeckman et al., 2013), such as neighborhoods, public buildings, urban roads or open-sky labs, also influence the characterization of LLs in terms of openness and user involvement. Along with the physical space, the LL literature has recently highlighted the growing prominence of virtual and technological spaces in creating a setting that could be perceived to be as real as the physical one (Bergvall-Kåreborn et al., 2009). Spaces based on virtual and technological tools, for instance simulators and virtual prototyping, can integrate the physical space in the creation of real-life settings for LLs (Bergvall-Kåreborn et al., 2009; Leminen et al., 2012), or even replace it based on the technology tested (Bergvall-Kåreborn et al., 2009) and the complexity of the environment in which the technology is used. However, in the case of technologies usually adopted in urban-like settings, such as automotive technologies, and in a complex environment of use, for example public roads, where regulatory and ethical issues are involved, the physical dimension is central in the definition of the space for the real-life setting of the LL (Dowling and McGuirk, 2020), while by complementing the open-air testing activity virtual and technological spaces can be considered as underpinnings of the physical dimension.

The social space is related to the dimension and the composition of the networks and to the quality of the relationships established between the actors involved in innovation processes. Social space is not neutral with respect to the ability of LLs to operate in a real-life setting. Favorable social space conditions (for example, an adequate scope and a purposeful composition of the network and collaborative relationships between actors) should be established before commencing any kind of innovation process.

Openness and trust are key enablers of the social space (Peschl and Fundneider, 2012), as they facilitate the creation of a real-life setting that assembles different actors and in which users – identified as trustworthy subjects – are concertedly involved. Openness and trust are intertwined with cognitive and emotional spaces, which, due to the more general purpose of this study, are not disentangled from the related social dimension. Similarly, the epistemological dimension of ESSs are not considered, since an in-depth analysis of knowledge creation and transfer is beyond the aim of this paper, despite the relevance of the knowledge-innovation nexus in LLs.

Finally, organizational space encompasses all the tools that need to be deployed to foster innovation processes in a real-life setting. It is engrained in the need to coordinate the actions and interactions of the actors involved, who are asked to take relevant decisions about the LL and the testing of technologies. The organizational space of the LL is affected by the degree of openness toward new partners invited to participate in the LL (Veeckman et al., 2013), and the level of decision-making power that potential users and involved actors hold (Bergvall-Kåreborn et al., 2009). Openness to new participants and the distribution of decision-making powers interrelate with the social (within which the network of actors involved is entrenched) and physical dimension of the LL.

### 3. Research design

In line with its theory-enlarging purpose (Patton, 2002), this study adopts a qualitative research design and abductive approach (Dubois and Gadde, 2002). Two different automotive LLs were selected as case studies (Yin, 2003), purposefully chosen for their technological similarity and for their both being located in Italy, so as to neutralize any contextual elements related to national regulatory frameworks (Table 2).

Both LLs pursue projects related to ACV technologies, which are considered one of the most impacting disruptors in the automotive industry (Kaur and Rampersad, 2018) and on everyday future mobility. Despite all the acknowledged benefits associated with ACVs, such as the enhancement of road safety and the decrease in traffic congestion (Fagnant and Kockelman, 2015; Paden et al., 2016), some factors still hinder not only their adoption (Zhang et al., 2019), but even their testing. For instance, security and regulatory issues are limiting experimentation of ACVs in real-life settings (Scagliarini, 2019). And yet, testing ACV technologies in a real (yet

**Table 2.** Overview of case studies

Name	Length	Technological field	Purpose	Network	Location
JRC LL	2019 – on going	New forms of mobility	Testing a variety of mobility-related policy and regulatory approaches in a real-life environment	European Commission, Joint Research Centre, start-ups, university spin offs, consultant firms	North Italy – JRC site in the municipality of Ispra, in the province of Varese)
MASA	2017 – on going	Autonomous and Connected Vehicles	Testing autonomous and connected driving technologies and their interaction with other elements of the urban space	University of Modena and Reggio Emilia, Municipality of Modena, automotive and Information and communication technologies (ICT) sector firms	North Italy – In a neighborhood of Modena

Source: Summation by the present authors.

safe) setting, open to the potential users, within a LL properly designed in its physical, social, and organizational spatial dimensions, could be of paramount importance (Dowling and McGuirk, 2020).

Data were collected from multiple sources to ensure validity and reliability (Yin, 2003; Aguinis and Solarino, 2019). Primary data were collected through semi-structured interviews with key informants of the LLs. In order to triangulate the information, interviews were requested from more than one key informant per LL. Questions aimed to understand the actors involved within the LL and to deduce the main characteristics of the physical, social and organizational spatial dimensions thereof (see Appendix Table A1). Each interview was attended by two authors and lasted on average between 60 and 90 min. Each interview was followed by a discussion between the authors to add fruitful and informative observational data to the evidence collected. All interviews were recorded and transcribed verbatim. Secondary data were collected through internal materials conveyed by the key informants, institutional websites, and web-based press reviews.

As regards both the JRC-LL and the MASA, the data collected consist of primary and secondary data (Table 3). The collection of interviews and materials was driven by the saturation criterion, and ended when concepts and descriptive elements of the spatial dimensions of the LL began to repeat themselves. In addition, two of the authors participate in MASA research activities and brought their own direct experience and direct observational data. For this reason, fewer interviews with key informants were required to reach concept saturation level.

All the materials collected were triangulated and merged within a unique corpus of text, with the aim, firstly, of describing in depth each case in relation to the dimensions of ESs and, secondly, to compare the

two cases by examining similarities and differences. The authors independently analyzed and codified the texts by comparing iteratively emerging elements from the cases to the theoretical framework (Dubois and Gadde, 2002). The authors then discussed the patterns and results that emerged until they arrived at an agreed interpretation.

## 4. Results

Results are presented in line with the theoretical framework, describing the identified spatial dimension for each LL, with the aim of highlighting the real-setting environment through its physical characteristics (physical space), the relationships between actors (social space) and how LLs are managed (organizational space). Table 4 compares the elements emerging from the two cases.

### 4.1. The JRC-LL case

#### 4.1.1. The physical space

The JRC-LL is located in the municipality of Ispra within the Joint Research Centre (JRC), the science and knowledge service of the European Commission (EC) which tests new mobility solutions to support and improve European policies (JRC, 2021) empirically. As the interviewees explained, the intention to create a LL arose in 2019 when top management launched a new strategy to make JRC sites more open, efficient, sustainable and smarter (JRC strategy 2030), while accomplishing Green Deal priorities and Sustainable Development Goals. Indeed, for future mobility solutions, the JRC-LL represents the transport structure of the site in which it is located. It comprises '36 km of internal roads, more than 2000 people working in the Ispra site,

**Table 3.** Data sources

Kind of sources	JRC-LL	Masa LL
Primary sources (Interviewees = I)	<ul style="list-style-type: none"> <li>• I1a. Governance actor, scientific activities coordination</li> <li>• I2a. Governance actor, scientific activities support</li> <li>• I3a. Governance actor, policy coordination</li> <li>• I4a. Governance actor, project management</li> <li>• I5a. Actor from a start-up collaborating with the LL</li> <li>• I6a Governance actor, scientific activities</li> </ul>	<ul style="list-style-type: none"> <li>• I1b. Governance key actor from the university</li> <li>• I2b. Governance key actor from a company involved in the LL</li> <li>• I3b. Governance key actor from the municipality</li> <li>• Participant's observation of the authors</li> </ul>
Secondary sources	<ul style="list-style-type: none"> <li>• Call for expression of interest (available online)</li> <li>• EC Website – JRC</li> <li>• Policy report 2018, 2019, 2020, 2021 (available online)</li> <li>• Informative articles and scientific output by JRC research group (internal presentation, scientific papers, conference proceedings)</li> <li>• EnoLL workshop, 2021</li> </ul>	<ul style="list-style-type: none"> <li>• 6 memoranda of understanding</li> <li>• 25 Letters of interest</li> <li>• MASA Website</li> <li>• Informative articles and scientific output by MASA research group (scientific papers, conference proceedings)</li> <li>• Online available conferences and public engagement events</li> </ul> <p>C1: Motor Valley fest 2020; C2: Motor Valley fest 2021; C3: Milano Smart City Conference 2019.</p>

Source: The present authors.

and it is considered like a small town. Also, because it is closed from the outside and we take care of the entire management of the site' (I1a). JRC-LL was then created alongside the already present LL for Testing Digital Energy Solutions (DES-Lab) on new forms of mobility, and its physical space consists of a closed area of 213,000 m<sup>2</sup> and more than 80 buildings in the Ispra site, managed by the JRC itself (Figure 1).

The area already had a wide variety of infrastructural elements such as straight road segments and curves, roundabouts, various types of zebra crossings, and different parking area layouts. Moreover, to allow safe and effective testing of new mobility solutions, an urban test-track, composed of a 600 m long closed circuit with three intersections and a roundabout, was added. The infrastructure has been modified over the years to include two signalized pedestrian crossing points, as well as other technological infrastructures such as a variable message sign to alert users as to the arrival of other vehicles (Table 4).

#### 4.1.2. The social space

From the very outset, the physical space involved all the actors for the functioning LL. Firstly, the JRC was responsible for providing the necessary infrastructures, disseminating results and for aligning activities with the national regulations for ACV road testing. As one of the interviewees pointed out, 'on account of its being closed from the outside [...] we take care of the entire management of the site which means that [...] we also undertake the role of

the municipality. This is because we are in charge of applying the law, meaning Italian law, within the site [...] and there are 2000 people who then need to move throughout the day for various reasons, so there is an significant flow' (I1a).

Secondly, companies brought know-how and technological innovations and made it possible to take full advantage of all the facilities and infrastructures. In addition, the JRC-LL opened up a public call to 'attract the interest of different start-ups and SMEs' (I2a) and to collect expressions of interest by industrial partners engaged in testing new mobility solutions. These activities promoted the openness of the LLs by incentivizing the participation of different industrial actors. Once industrial partners were selected, collaboration agreements were issued to define the activities of interest within the remit of both parties. Indeed, from the very beginning, the companies that joined the LL were SMEs, start-ups or spin-offs with an engineering background. The industrial partners then used the JRC-LL mainly as a protected site to carry out on-road tests, while scanner attention was paid to the interactions of the technology with the end users. Indeed, as one interviewee stated, 'in some cases, I would say that these companies did not have a LL in mind, but merely wished to validate their technologies. They did not see the real LL added value in the projects' (I2a), but rather used the site more as a platform to test the technologies than as a proper LL.

Finally, users were represented by the employees and the approximately 200 visitors per day of the JRC

**Table 4.** JRC-LL and MASA spaces

	JRC-LL	MASA
Physical	<p>Area</p> <p>Urban-like Infrastructures</p> <p>Technological Infrastructures</p>	<p>Open area within a neighborhood of Modena</p> <p>Civil and residential buildings, a school, a healthcare center and a library; road crossings, roundabouts, an overpass and a parking area</p> <p>Autodrome of Modena – 2 km of racetrack for testing new mobility solutions at the embryonic stage</p> <p>5G, 4G, LORA network, traffic and pollution sensors, traditional and smart cameras. Data Centre, virtual simulators.</p>
Social	<p>Type of industrial actors</p> <p>Role</p> <p>Mechanism of involvement</p> <p>Type of users</p> <p>Role</p> <p>Mechanism of involvement</p>	<p>Firms from the automotive and ICT sectors.</p> <p>Providing devices and technical skills to MASA</p> <p>Memorandum of understanding, Letter of Interest</p> <p>Inhabitants of the neighborhood</p> <p>Interacting with technologies</p> <p>Public initiatives and seminars, inhabitants' perceptions, sharing of information on traffic status</p>
Organizational	<p>Type of research actors</p> <p>Role</p> <p>Mechanism of involvement</p> <p>Type of policy actors</p> <p>Role</p> <p>Mechanism of involvement</p> <p>Actors</p>	<p>University</p> <p>Research, disseminating results and providing technical and research skills</p> <p>Memorandum of understanding</p> <p>Local Municipality</p> <p>Managing the area, supporting on-road testing, involvement of residents</p> <p>Memorandum of understanding</p> <p>Companies participating in LL, University, Local Municipality</p>
Governance model	<p>Central/Vertical</p>	<p>Shared/Horizontal</p>

Source: Summation by the present authors.



**Figure 1.** The physical space of JRC-LL. *Source:* JRC internal document. [Colour figure can be viewed at [wileyonlinelibrary.com](https://onlinelibrary.wiley.com)]

in order to gain insights into how they interact with technologies. Over time, some mechanisms have been adopted to aid the engagement of users, such as the exploitation of the Makerspace, a collaborative space designed to promote active participation and smoother cooperation with JRC employees and external visitors through impromptu experimentations and focus groups. Moreover, the initial involvement of an external advisor, with experience in service design and user research methods, was useful in the adoption of the six-step methodological approach from Mastelic (2019). Based on Design Thinking, this multi-method approach incorporates a wide range of strategies (see Table 4) to engage users in open discussion and an exchange of ideas. In addition, email broadcasts have been used to invite all employees to participate directly in co-design activities. Alongside this, several displays have been carried out with the aim, on the one hand, of displaying to the public at large the results from technological experimentations and, on the other, of revealing to the companies the importance of user feedback. Consequently, as one interviewee put it, ‘they [users and industrial

partners] started somehow realizing what a LL is, they started to trust more in the innovation’ (I2a).

#### 4.1.3. *The organizational space*

Within the organizational space of the JRC-LL, ‘at the operational level, [the governance] was imposed from the top to understand who was responsible for what. From the bottom we [the JRC] have created a co-group of implementers in which there are two people for each scientific unit [...] choosing activities that seem more interesting and reporting what has been developed to the directors who then have the last word [...]’ (I5a). There is therefore a two-level hierarchical configuration of the organizational space. At the top, a group deals with the general activities and objectives of the LL, having representatives from different directorates: the scientific directorate supervises technical activities, carrying out collaborations with companies that test their technologies; conversely, the JRC support services deals with logistics, equipment and infrastructure, in compliance with the rules of the site and national regulations. At the bottom, the organizational space resembles the spontaneous development of the social dimension of the LL, and only

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recently have roles been defined in the implementation of daily operations. ‘The current set is the output of a very spontaneous development of this project. [...] For example, I wanted to stay on the project and then this connection appeared rather spontaneously [...]. But the governance is in a flux’ (I3a). The JRC operational core team manages the applications of new partners interested in LL activities and the relationships with policy Directorates General (DGs) of the EC and across JRC units. The JRC Research Ethics Board (REB) ensures that JRC research complies with ethical standards and principles of the EU framework programs. In addition, the JRC-LL Management and Evaluation board sets the goals of LL projects and brings them into line with the aim of providing evidence of interest to policymakers. Given the LL’s reliance on policies enacted from Brussels, the direct inclusion of other DGs in governance has been proposed, with the goal of achieving results that are more in line with the objectives of policymakers.

What emerges, therefore, is an organizational space where the key decisions on the development of the LL are related to its institutional nature and objectives, and in which the top management actor coordinates the activities of the operating group, which in turn manages relations with industrial actors and users.

### 4.2. The MASA case

#### 4.2.1. The physical space

Located in a neighborhood in the northern part of the city of Modena, MASA aims to develop and validate

experimentally innovative solutions for an intelligent urban mobility, focusing on ACVs, Advanced Driver-Assistance Systems (ADAS) and protocols of interaction among vehicles and the surrounding urban environment (V2V and V2X). The LL is located at the heart of the Italian Motor Valley, where a strong presence of well-known car manufacturers and highly specialized SMEs are grouped in the local automotive industrial district. Within this context, the idea of a space to test ACVs was proposed in 2017 by an important car manufacturer. The LL was established in an urban area agreed upon with the municipality of Modena, taking advantage of a tender for suburban redevelopment to finance part of the necessary infrastructure. The area of approximately 3 km<sup>2</sup> has several civil and residential buildings, which increase the environmental complexity in performing the technological testing. As stated during a conference, ‘since we had to redevelop the area, why not try to build an urban lab? [...] We have therefore tried to concentrate possible use cases of interest for ACVs technologies: a library with a parking lot, a school, a healthcare centre and a train station with other parking areas and significant traffic flows, and a traffic light crossing simulating visibility problems from one direction to another’ (C3). Once identified, the area was gradually equipped with the necessary infrastructure technologies to allow for on-road testing (Table 4) as well as a computing infrastructure, known as the Data Centre (Figure 2).

In addition to the open urban area that is the core of the LL, a private area within the Autodrome of Modena has been added to pre-test the technologies



**Figure 2.** The physical space of MASA. Source: MASA website (n.d.). [Colour figure can be viewed at [wileyonlinelibrary.com](https://onlinelibrary.wiley.com)]

in a closed environment. Early stage technologies are developed and tested on the track and with the support of simulators at university research centres. The physical dimension of MASA is therefore configured as an open space, which recalls the essential elements of the urban neighborhood, for pre-testing and technological development that complement the city circuit for V2V and V2X interaction (Table 4).

#### 4.2.2. *The social space*

MASA social space was built with the indispensable participation of the local municipality, the local university and industry players. As evidenced by the analysis of memoranda of understanding, three important industrial partners joined the project and replaced the initial promoter, bringing infrastructure and technical skills to MASA. Along with these main associates, other potential industrial companies from the automotive, ICT or related sectors signed letters of interest (LOI) expressing their willingness to participate in MASA's specific activities, albeit with no involvement in the LL's governance. Through spontaneous social interaction, each partner takes on a specific role for the efficient functioning of the LL: the municipality by making the urban area available and facilitating road testing, and providing the necessary permits and the closure of roads to traffic; the university with skills in basic and applied research into technologies, but also into legal and economic issues; and the main industrial players with their technical and industrial research skills, and by making devices available.

At first, enlarged working groups were envisaged to foster a collaborative climate conducive to the creation of a social space, where MASA's main objectives could be shared and the project's first steps could be made. Once these enabling conditions were achieved, working groups were restricted with the remit to attempt to accelerate decisions, within a more operational social space. In particular, the three main industrial partners were the most directly involved in the running of MASA activities, with the support of the municipality and the university. As stated by one of the interviewees, 'We have always tried to keep the groups very open to allow those who attended to understand what was happening. [...] Then it was obvious that those from that group of relationships that managed to consolidate went ahead, so the need for enlarged groups expired' (I1b). It was within these restricted working groups that the idea emerged to involve users in MASA activities by exploiting the natural testing opportunity represented by the opening of the LL's social space to the inhabitants of the

neighborhood. Being a physically open space, it was not strictly necessary to adopt active mechanisms to involve users. Rather, interaction with them was obtained by means of the physical dimension of the LL's space. A further interaction with inhabitants is favored by the establishment of a Data Centre within the urban testing area. Data collected in the area can be returned to them as instant information on road conditions (potholes or the weather), traffic flows and accidents. In addition, events and public initiatives were organized within the urban area, as well as seminars, to disseminate knowledge among residents about the innovation activities taking place in the LL.

#### 4.2.3. *The organizational space*

By quite spontaneously assuming specific roles within the social space, each actor, according to its nature, skills and degree of involvement, had an influence in the formation of the organizational space. The first formalization thereof dates to the signing of agreements and memoranda of understanding, which established the roles, tasks and areas of intervention of the various actors. The complementarity of the roles they played in the formation of social space placed all the actors at the same horizontal level, leading to a diffused and balanced decision-making power between the participants. If, on the one hand, the emergence of a horizontal logic in decision-making allows the pursuit of different and complementary interests and objectives, on the other this requires more time and coordination to align languages and working methods. Similar to what emerged spontaneously in the social space, the organizational space of MASA came into being around a restricted working group with the aim of guiding the broader developments of the LL, while eight research groups from the university had already started pursuing the development of technologies from a multidisciplinary perspective and coping with the emerging issue related to the circulation of ACV technologies on open public roads. Indeed, when the ACVs started to interact with city life, legal and administrative issues materialized that were of pivotal importance. As testified by one of the interviewees: 'we are now stuck in how to manage security, and this is perhaps the most difficult challenge. It is much easier to have a car that drives alone on the street without any [technical] risk than to understand how to make it to drive alone on the street without any legal risk' (I2b). Overcoming these obstacles would allow for greater and easier involvement of users in the innovation process. In addition, and as expressed by one of the interviewees, 'it is a

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question of inventing an organizational mechanism that can support the economic activities related to the LL' (I2b), leading to further progression of its organizational space.

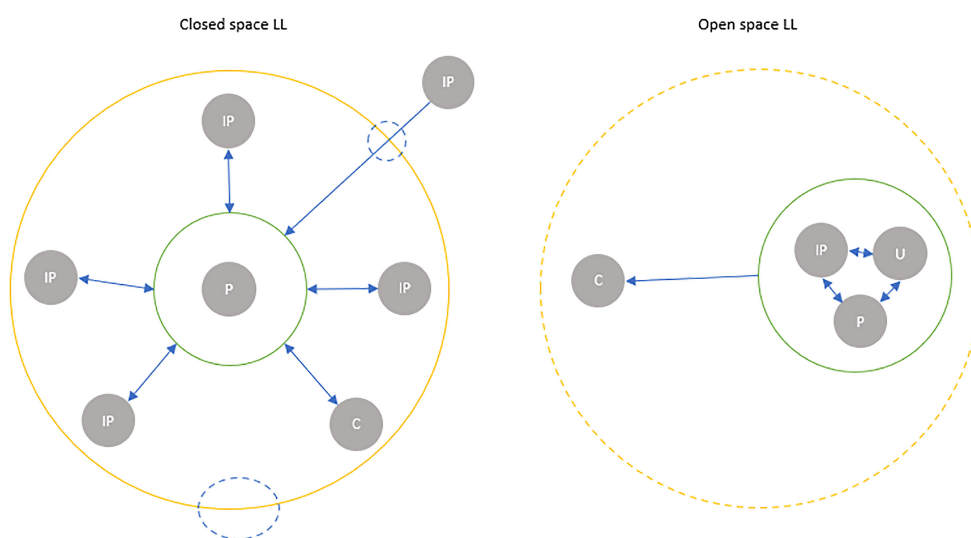
The organizational space of MASA is therefore transformed into a location for dialog and for the advancement of proposals for overcoming barriers and implementing national legislation for road experimentation (the so-called Smart Road Decree – see Scagliarini, 2019).

## 5. Discussion

Results show how the peculiarities in the dimensions of ESs influence the characterization of JRC-LL and MASA as LLs. The first and main element of difference is embedded in their physical space, as an expression of the real-life setting (Veeckman et al., 2013). By exploiting the already existing structure of the JRC, the JRC-LL's physical space looks like a small city closed by in from the outside. The space in which the JRC-LL grows is owned by the EC itself and is therefore protected. Conversely, MASA, located in a real-life neighborhood, is an open space which leads to a more natural collaboration between different actors. To embrace an OI vision, the JRC-LL activates several mechanisms aimed at making its physical boundaries more porous. For example, the open call for expression of interest and the Makerspace allow the closed space to become a space open to collaboration and creation. Contrariwise, being placed

in an open physical space, MASA is a natural setting where OI can transpire. It is arguably the case, therefore, that from these differences in physical space, variances in social and organizational spaces follow logically, leading to distinct configurations of the two LLs and their governance models (Figure 3).

In comparing the cases, it emerges how differences in the physical space may, first of all, determine a diverse evolution of social space. On the one hand, a real-life setting based on a closed physical space requires formal actions to open borders and establish relations with the outside actors. Relationships between actors interrelating in the LL, such as industrial partners and JRC staff, must be built, defined and regulated. The entity in charge of the management of space makes strategic decisions that have a direct impact on the social dimension of the ES, and thus on the openness of the innovation practices. For example, decisions about which rules to adopt to regulate the access to the area have a direct influence on the number and type of actors to involve and the selection that takes place. The formalization of *a priori* roles and rules can therefore impact on the nature of the relationships. Furthermore, the institutional nature of the entity responsible for administering the physical space may have an effect on the social dimension of the ES for the LL. As the aim of the JRC is to define guidelines for European policies in the field of mobility, and as the independence of the public entity is critical to ensuring the neutrality of the policy advice, the social space enabling LL testing activity may be shaped by the



**Figure 3.** Spatial dimensions of the two LLs. *Note:* The yellow line represents the physical space that leads to diverse mechanisms (dashed blue line) to activate the social space. The social space is defined by the arrows between the actors. The organization space is identified by the green circle. Actors: IP = Industrial partner, C = Citizens / end-users, P = Public institution, U = University. *Source:* The present authors. [Colour figure can be viewed at [wileyonlinelibrary.com](https://onlinelibrary.wiley.com)]

primary goals pursued. Conversely, the open nature of MASA's physical space leads to the evolution of the social space toward less pre-defined relationships and access rules, so that the degree of openness and the kind of private and public actors involved change flexibly, depending also on the goals pursued. The development of the social space in MASA is therefore different with respect to the JRC-LL. While the latter needs to adopt mechanisms to lower the hindering effect that closed physical boundaries and strictly regulated access may have on the LL's openness, MASA, being located in an open space, requires mechanisms to draw these boundaries more clearly, in order to enable more purposeful and targeted interactions for innovation in LL's social space. For example, the narrowing of working groups in the social space of MASA is due to the necessity of involving only those partners capable of contributing to the definition of rules for testing technologies on urban roads, including procedures for obtaining permits from regulatory bodies to test innovation projects. Furthermore, if, in the case of the JRC-LL, trust is based on formalized rules of access and compliance with them, in MASA trust has to be consolidated and confirmed over time by the actors through a continuous alignment of their own actions to the achievement of the common objectives (Peschl and Fundneider, 2012).

Secondly, the involvement of users under a UI logic also takes a different form, based on the connotation of the physical space. In the JRC-LL, the end users are the employees themselves (even those not directly involved in LL activities) or visitors to the site. Although they do not represent a truly realistic sample of the population, they do take part in the innovation project more effortlessly and actively. The co-creation with the end users, which occurs in the Makerspace through focus groups and a Design Thinking based approach, is also guaranteed by the fact that the majority is interested in participating. Indeed, the LL is located within a closed community involved and interested in innovation processes and mobility issues. Conversely, involvement of end users is more difficult in MASA. In fact, the end users of MASA are the very people living in the neighborhood where the LL is located. By making the most of its open space, MASA has the opportunity to analyze and observe in a more vivid way the interaction of ACVs in a real-life setting. However, it is more difficult to involve and establish co-creation processes actively, especially with those who are not innately interested and/or trained in the experiments carried out within the LL.

With the definition of their social space, LLs transform into multi-stakeholder platforms (Leminen

et al., 2012), where actors of different natures are funneled into the same space. The social interaction of the actors requires the definition of an organizational space within which they can operate, and hence entails demarcation of the governance of the LLs (Bergvall-Kåreborn et al., 2009). In both LLs, the governance model is the output of a spontaneous process reflecting the physical space and the evolution of the social space. For example, a diverse collaboration with the industrial partners takes place. In the case of JRC-LL, the characteristics of the closed physical space has led to a more vertical management of relationships: companies apply through the call of interest and are directed to establish an individual relationship with the JRC-LL. In this sense, the governance network takes the form of a lead organization (Provan and Kenis, 2007): major decisions are taken by the entity identified as the owner of the space, who also manages each relationship with industrial partners. In conjunction with JRC staff, the latter define the time and aim of their single projects, even without having a complete overview of the entire action of the LL. Contrarily, in MASA a horizontal involvement of the players is pursued, leading to a form of governance in line with that of a shared participant governed network (Provan and Kenis, 2007). The main industrial partners, the university and the municipality participate in all activities and make jointly strategic decisions for the LL, in a logic of multi-stakeholder collaboration. Indeed, for each project the open space requires the intervention of the public authority as a regulatory body to guarantee permits for on-road testing. For their part, the industrial partners contribute to technological experimentation and innovation in collaboration with the university, which, as orchestrating actor (Tagliacruzchi et al., 2021), also ensures a neutral collaboration space for potentially competing interests.

Finally, both LLs depict an organizational space that evolves over time to face challenges related to the management of interdependencies with the other spatial dimensions. The JRC-LL organizational space is steered toward a configuration that could better reconcile the need to manage projects from external players in a flexible manner in relation to the demands of the centralized structure imposed by the institutional framework. For this reason, the JRC-LL has also proposed to include higher-ups in its governance to streamline the communication flows between the top management of the overall JRC structure and the LL, and to find mechanisms that could simplify the bureaucratic processes that may slow down the LL's activities. MASA, on the other hand, being located within a public and open area, is seeking an organizational space arrangement

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which could support the testing activity by university researchers and industrial partners by dealing with the hindering effects of national legal and regulatory issues. For example, although compliance with national regulations is required, in the JRC-LL the problem of road safety related to the testing of ACVs does not require direct engagement with decisions taken by national and/or local regulatory authorities, as the regulatory body for the area is also the owner of the site. In MASA, as road safety issues can be dealt with only by obtaining permits from national and/or local regulatory bodies for each test project, the organizational space is moved toward a configuration where actors and regulatory bodies are required to be flexibly involved in each decision-making process.

## 6. Conclusions

Considering LL as a space for fostering innovation, this paper has proposed an analysis of two LLs involved in the same technological field, and has addressed the call for a better understanding of the influence the space has on LL by leveraging the concept of ESs (Peschl and Fundneider, 2012, 2014). In an attempt to define a theoretical framework for the real-life setting, the paper has offered several contributions to the debate. First, by analyzing LLs from an ES theoretical perspective, the findings show how the physical, social, and organizational dimensions of ES interrelate and how they influence the evolution of the LL. The presence of a closed and protected physical space is related to the emergence of social and organizational spaces in which the decision-making power of the actor managing the area is central. Conversely, an open physical space makes possible the creation of a social and governance space less centred on a single leading actor, thereby granting different institutional entities, public authorities included, the decision-making powers required to manage the LL. Secondly, the findings of this paper suggest that openness, user involvement and a real-life setting, as constitutive concepts of LL, are intertwined and bolster each other in shaping effective LL activities. This paper has therefore argued that a real-life setting based on a close physical space is likely to favor the involvement of end users with a high level of motivation to participate in the innovation process, whereas OI logic is more difficult to implement. On the other hand, when the real-life setting is an open physical space, OI approaches are easier to implement, while users (albeit potentially much more numerous and spontaneously engageable) are likely to be less involved in the co-creation process.

Thirdly, some implications have been drawn for the LL governance model, as this paper has observed that the management of a physically closed real-life setting has been associated with the formation of a lead organization governance, while a shared participant governance naturally follows the establishment of an LL in an open space. Finally, by offering more evidence on how LLs are performed in practice (Paskaleva and Cooper, 2021), this paper has contributed to the advancement of the debate by focusing on an as yet understudied type of LL, namely the automotive industry, discussing how the type of technology involved, its complexity and the characteristics of the usage environment influence the configuration of the real-life setting and the ES dimensions considered. This paper has also offered practical implications in supporting managers and practitioners in performing innovative activities, projects or management tools. It has pointed out how the construction of an LL could not commence without careful reflection on the physical space and how this can influence mechanisms supporting the relationship with the other actors and the very governance of the LL.

However, awareness is required of the greater complexity implied in the analysis of spatial conditions affecting LLs as ESs. Several limitations arise, leaving room for the following areas of research. Firstly, although an initial contribution has been made to a relatively new and promising stream of research on LLs, the generalization of the results is low. Secondly, a deeper discussion about micro-level practices is also needed, looking in depth at single projects driven within the LL and how they have been managed. Prospective research could involve more case studies, cross-country samples, or LLs based on different types of innovation. Future empirical studies should also consider the epistemological spatial dimension, given the strong nexus between knowledge creation knowledge transfer and community-based innovation practices.

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## Data availability statement

Data sharing is not applicable to this article.

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APPENDIX

**Table A1.** Interviews protocol

Background and context	Roles and responsibilities Vision and mission of LL
Physical dimension	Physical structure Management of activities within the area (infrastructures and places) Technologies implemented within the area
Social dimension	Participants and roles of different actors Difficulties and main barriers in co-managed projects Changes in the network over the years End-user relationship Future perspective for the network of actors collaborating within LL
Organizational dimension	Foundation and organization of the LL – main difficulties Governance and actors taking part Changes within the governance Management of the differences in the objectives of single actors Organization of activities (on an administrative level)
Conclusions	Main issues to be resolved for the development of the LL Expectations VS actual results Medium long-term goals

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