



# Living labs: Challenging and changing the smart city power relations?

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## ARTICLE INFO

### Keywords:

Citizen inclusion  
Living labs  
Organising collaborative systems  
Power relations  
Smart cities

## ABSTRACT

Smart cities refer to place-specific collaborative systems where multiple actors collaborate to collectively address public problems. However, smart city initiatives regularly frame citizens as the weakest link, as passive consumers rather than active creative agents. This article argues that power imbalances between citizens and other organisational participants structurally mute citizens' voices, ultimately compromising smart cities' aims. Living laboratories are a popular smart city intervention that have the potential to address this power imbalance and empower citizens to influence smart city development. This research theoretically and empirically explores this role of living labs through a multiple-case study of urban living labs in the region of Catalonia. The findings uncover a 'power banking' mechanism which, coupled with other critical factors, facilitates the effectiveness of such initiatives. The considerable efforts required to engage citizens at a fairly basic level suggest that incorporating citizens into smart city models is more challenging than simplistic Quadruple Helix discourses convey.

## 1. Introduction

Cities face increasingly complex sustainability issues, such as social inequality and environmental pollution, and 'smart city' notion have emerged as a promising solution to these challenges (Albino et al., 2015; Kummitha and Crutzen, 2017). Smart city development is a rapidly growing interdisciplinary area of research conducted across various contexts, a situation which has led to the absence of a singular definition (Mora et al., 2017; Ricciardi and Za, 2015), although the term was first used in the 1990s (Mahizhnan, 1999). Meijer and Bolívar (2016, p. 398) propose that a city is smart when it is able 'to attract human capital and to mobilize this human capital in collaborations between the various (organized and individual) actors through the use of information and communication technologies' (ICT). Combinations of three aspects are emphasised, including technology (smart technology), governance (smart collaboration) and human resources (smart people).

The concept of a smart city emerged as a primarily technological discourse about the opportunity for ICT to improve quality of life through innovative urban infrastructures (Borkowska and Osborne, 2018). This approach grew encompass the idea of governments and knowledge institutions co-operating with businesses, in what is known as the Triple Helix innovation model, to solve diverse urban challenges

(Dameri, 2017; Leydesdorff and Deakin, 2011). However, the actors in these collaborations tended to prioritise deploying technologies above aligning those technologies with citizens' needs (Hollands, 2008; Kummitha, 2018). Critics have therefore called for a human-centred vision of smart cities, one that involves citizens in the development process (Andreani et al., 2019; Vanolo, 2016).

Living labs (LLs), a recently popular urban policy instrument in Europe, aim to stimulate an inclusive and collaborative ecosystem in shaping smart cities (Bifulco et al., 2017; Santonen et al., 2017). LLs facilitate multiple stakeholder collaborations and are user-centred in their efforts to co-create innovation in real-life contexts (Eriksson et al., 2005; Leminen et al., 2012). The rise of several LLs comprising local (place-based) and social (citizen-driven) dimensions (Neirotti et al., 2014; Scholl and Kemp, 2016) could be regarded as a new urban phenomenon that favours citizen inclusion.

However, despite the perceived importance of citizen inclusion, power imbalances between individual citizens and organisational interests remain fundamental concerns of LL practice (Engels et al., 2019) and undermine collaboration outcomes (Kähkönen, 2014). Scholars have thus cited the need to explore the mechanisms that LLs have in place to address concerns about inclusion and power and fulfil their goals in urban contexts (Hossain et al., 2019; Kronsell and Mukhtar-

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Landgren, 2018). Accordingly, this paper explores whether and how LLs include citizens in ways that change power relations with other organisational participants in smart city collaborative systems. This theoretical and empirical enquiry starts by seeking to understand how citizen power is sourced and acknowledged, the practices that LLs implement to include citizens and the impact of those practices on power relations.

Understanding power relations is critical to successfully organising inclusive and collaborative ecosystems in urban contexts. According to Clegg et al. (2006, p. 1), 'Power is the most central concept in the analysis of organization(s) and organizing', as power relations among different stakeholders, including citizens, shape and reshape participant capabilities and decisions, and vice versa. However, while power has been largely explored inside organisations (Barley, 2010), it has been relatively neglected in the field of organising collaborative systems.

The research question is explored through a multiple-case study of seven LLs in Catalonia which sought citizen participation and knowledge input in smart city processes. The findings provide insight into the citizen participation process within LLs and analyse the perceived shift in power relations between citizens and other stakeholders. Based on the evidence, the discussion and conclusions suggest a mechanism for organising a more inclusive and collaborative ecosystem for smart city development purposes.

## 2. Theoretical background

### 2.1. Power as a contested concept

Scholars are paying increasing attention to the concept of 'power' and the role it plays in the organisation of society (Anderson and Brion, 2014; Clegg, 2010). The definition of power is manifold and constantly contested, as it embodies 'a cluster of concepts' (Avelino, 2021; Clegg and Haugaard, 2009, p. 3). Among those contestations is a classic debate over whether power is possessed (i.e. 'power to do or accomplish something') or exercised (i.e. 'power over another or others') (Pitkin, 1972, p. 277). Accordingly, power can be broadly conceived as the capacity of actors to mobilise means or to influence others' behaviours to achieve a specific purpose (Avelino, 2021; Turner, 2005).

Actors possess three main sources of power (Hardy and Phillips, 1998; Purdy, 2012; Ran and Qi, 2018): (i) *formal authority*, which is the acknowledged legitimate right to make decisions and is usually embedded within a given institutional context; (ii) *critical resource control*, which is participating actors' access to necessary tangible and intangible resources; and (iii) *discursive legitimacy*, which is the ability to influence social constructions by invoking values and societal norms while discussing certain topics, such as the environment or democracy. Classical theories of power from the 1950s relied heavily on resource dependency – control over necessary resources such as funds, technologies and knowledge – to explain actors' power positions (Turner, 2005).

The fact that power is relational has long been acknowledged, emphasising the dimension of exercised power (Foucault, 1982) over the mere possession of power. The contemporary literature on power tends to combine these two perspectives, proposing that the power positions of actors are dependent not only on power sources but also the relations and perceptions of others (Kähkönen, 2014; Purdy, 2012). Overall, within collaborative settings, shifting power relations is 'not just a matter of asking who has *more or less* power, but also about analysing the different types of power they exercise and how subsequent interdependencies change over time' (Avelino and Wittmayer, 2016, p. 644).

Power relations and positions affect collaboration outcomes, both positively and negatively (Clegg et al., 2006). On the one hand, balanced power produces deeper collaboration in which partners have equal possibilities to contribute (Kähkönen, 2014). On the other hand, power balance poses a risk of 'stalemate and inaction' (Gray, 1985, p. 927) in a 'shared-power' but 'no-one-in-charge' world (Bryson and Crosby, 2005, p. 1). However, it is commonly acknowledged that strong power imbalances limit the collaboration quality; the presence of dominant

participants undermines other actors' trust, interest and commitment, preventing the inclusive involvement of new partners and, in later stages, intensive collaboration (Kähkönen, 2014; Ran and Qi, 2018). Furthermore, a substantial power imbalance drives compliance behaviours when weaker actors face stronger actors that are capable of manipulating collective processes for private benefit (Ansell and Gash, 2008; Hardy and Phillips, 1998).

A delicate balance of power is achieved when no party has considerable domination and when underrepresented or less powerful actors have a sufficient voice in the system (Gray, 1985; Hardy and Phillips, 1998; Kähkönen, 2014; Menny et al., 2018; Purdy, 2012). In such cases, actors can shape the direction of the network and improve outcomes by influencing the decision-making process (Bickerstaff and Walker, 2005; Ribeiro et al., 2018). Empowering others by motivating them to participate in decisions increases the joint capacity for effective action (Purdy, 2012). That said, addressing imbalances requires the application of appropriate mechanisms; it does not happen spontaneously in collaborative arrangements (Huxham and Vangen, 2005).

### 2.2. Citizen inclusion in smart cities: a tale of power imbalance

Any kind of multi-actor collaboration is complex, and achieving an ideal synergy of dissimilar logics (public vs. private vs. civic) is difficult (Jensen and Trägårdh, 2004). While considering the balance of different logics and purposes, collaboration theories tend to assume – implicitly, if not explicitly – that all actors have similar power positions (Hardy and Phillips, 1998; Lin et al., 2018). Including citizens in urban collaboration is not easy because, unlike other urban actors, citizens are diffuse and weakly coordinated. Citizens lack resources and the collective power to deploy resources effectively (Huxham and Vangen, 2005; Rodrigues and Teles, 2017).

Smart city collaborative ecosystems can be conceptualised as a set of arrangements among Quadruple Helix actors, each of which has different sources of power (Fig. 1). In these collaborations, *governments* possess the strongest formal authority. They provide regulatory support for the collaboration (Etzkowitz, 2008), and they can offer or withhold critical resources, such as funding (Miller et al., 2016). Governments generally, and politicians in particular, rely on discursive legitimacy, so long as they are elected representatives of their citizens. However, doubts have been raised about the representative democracy model and its capacity to truly identify and fulfil citizen demands (Sønderskov, 2020), suggesting that governments' discursive legitimacy is weaker nowadays. The power of *industry* relies on the resource advantages provided by staff and technologies, which are used to produce products and services (Yang and Holgaard, 2012). While industry lacks formal authority, it has economic authority by creating economic value in society and determining citizens' economic welfare. Industry may have less legitimacy in this context than public sector actors; however, innovation imperatives have acquired a strong economic aspect in recent years (Fitjar et al., 2019). *Knowledge institutions'* main sources of power lie in critical resources, such as human capital and research expertise (Etzkowitz, 2008).

Lastly, participant *citizens* can exert power through their discursive legitimacy: citizens mobilised under civil society organisations (CSOs) are empowered to speak on behalf of society, and general citizens are affected by changes in social prosperity and environmental sustainability (Purdy, 2012). One could also argue that citizens represent a source of user know-how which could have value, especially for industry and public service providers (Von Hippel, 2005). However, there is asymmetry in this relationship; users provide their knowledge to innovators, who use that knowledge to develop better products that benefit citizens. If citizens withhold their knowledge to create leverage, then they suffer by receiving less useful solutions to their problems.

From a capacity-based perspective of power, citizen power positions may be eroded because citizens do not often possess 'the political power and authority of government and academia, and the economic power of

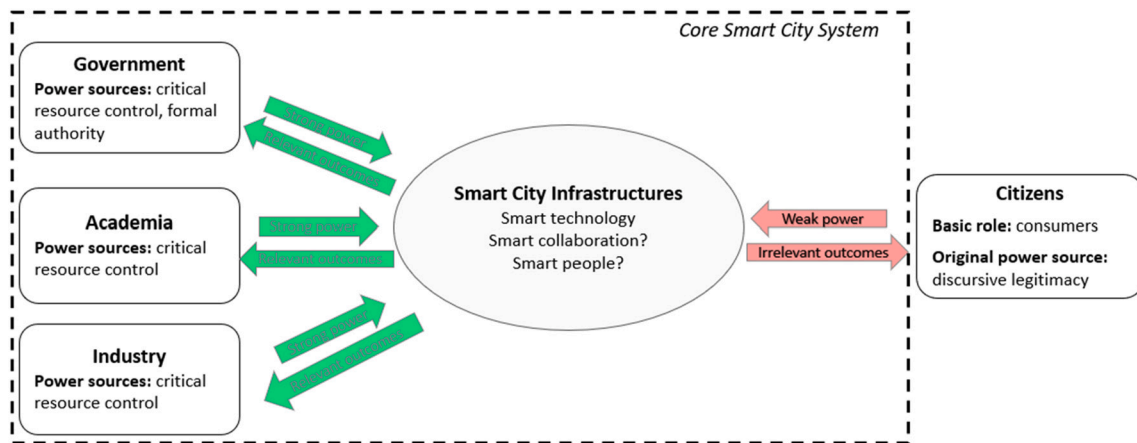


Fig. 1. Citizen power positions in smart city systems.

industry' (Borkowska and Osborne, 2018, p. 363). Similarly, from a relation-based approach, citizen roles may be undermined because they are loosely related to the Triple Helix participants and, therefore, lack opportunities to exercise power. In urban collaborative ecosystems, the strong co-dependencies and ties among the Triple Helix participants tend to have a technological focus (Mora et al., 2019), and these partnerships are resistant to new partners (Grundel and Dahlström, 2016; MacGregor et al., 2010).

The strong power imbalance is a hindrance to effective citizen inclusion in solving urban problems. Citizen exclusion may jeopardise the governments' capacity to represent its citizens in decision-making and instead encourage the promotion of its immediate partners in the business and university sectors. In this scenario, smart cities are failing to ensure that the voices of different citizen groups are heard, which reduces smart cities' capacity to better align services, infrastructure and management with what citizens want and need. Instead, smart cities' services, infrastructure and management are aligned with what technology corporations and knowledge institutions desire, engaging only citizens who are keen to embrace these high-tech niches (Andreani et al., 2019; Engelbert et al., 2019).

Overall, the issue of citizen inclusion is often oversimplified in the extant literature. First, scholars and planners who call for citizen inclusion – for example, through the Quadruple Helix model – rarely consider who citizens really are and 'which [...] opposing interests people in cities may have' (Engelbert et al., 2019, p. 347). Second, typical roles assigned to citizens, such as consumers, implicitly reflect power imbalances by imposing the dominance of market logic and tending to diminish the power and agency of actors who could concurrently be voters and activists (Avelino and Wittmayer, 2016).

### 2.3. Living labs as orchestrators of power relations

LLs are characterised by three main features: the involvement of users as early as possible in the innovation process; the use of co-creation processes with multiple actors; and attempts to simulate real-life problem contexts (Almirall and Wareham, 2011; Dell'Era and Landoni, 2014). In this way, LLs can be considered orchestrators (Reypens et al., 2019) that may facilitate a shift in power relations between citizens and other participants in collaborative ecosystems involving Quadruple Helix actors (Miller et al., 2016).

LLs seek to put users at the centre of their activities – as key sources of knowledge creation and innovation – and allow that knowledge to be influential from the outset (Bergvall-Kåreborn and Ståhlbröst, 2009; Eriksson et al., 2005; Leminen et al., 2015). Although citizens, as users, may play both passive and active roles in LLs, some authors have emphasised the particular advantages of the latter case where citizens act as not only consumer agents but also creative agents (Leminen et al.,

2015). LLs typically facilitate intensive interaction between 'innovators' and 'users' in ways that allow users to co-determine and shape innovation processes (Feurstein et al., 2008). Finally, LLs organise these activities in environments that are familiar to users, such as care homes (Kanstrup, 2017), or attempt to create or replicate specific contexts within which problems arise to facilitate the development of solutions that account for the complexity of real-world environments.

Taken together, these features mean that LLs could conceivably serve as not only co-creative environments that foster collaborations that advance social change but also power-exercising arenas where dominant actors potentially impose their logics (Arnkil et al., 2010; Puerari et al., 2018). Understanding how LLs facilitate citizen inclusion in ways that challenge and change power relations between participants is therefore critical but underexplored (Hossain et al., 2019; Kronsell and Mukhtar-Landgren, 2018). This article investigates this overarching question by testing whether the theoretical possibilities associated with LLs are deployed in practice. Following the concept of power as something that is possessed and exercised (Pitkin, 1972), this empirical analysis of LL practices explores first the power acknowledged to citizens and other stakeholders and second how this power is exercised, as well as how it mobilises means and influences others' behaviours to achieve a purpose (Avelino, 2021; Turner, 2005). Finally, the article explores the impact of LL activities in changing power relations.

### 3. Research method and context

We adopted an exploratory multiple-case study approach to investigate this research area (Yin, 2003). Research based on cases enables the generation of deep context-dependent knowledge (Flyvbjerg, 2006), which is especially valuable for understanding multiple-actor interactions (Ott and Kiteme, 2016) and therefore applicable to smart city research (Bibri and Krogstie, 2017). As LL activities typically operate with a local and regional scope (Mulvenna and Martin, 2013), studying several LLs in the same region allowed us to observe the diverse nature of stakeholder engagement, which is shaped by common regional factors. Cases were included when they seemed likely to cover specific processes, such as the potential power relations between citizens and other Quadruple Helix players in smart city contexts. The selected cases included LLs that aimed to (i) include citizens through active roles in working processes, (ii) work with other Quadruple Helix actors, and (iii) address different urban challenges, irrespective of its working area.

We selected Catalonia, a region located in northeast Spain, to study smart cities, citizen inclusion and LLs. First, the region is known for its smart city focus. Barcelona, the region's capital, has long been recognised as a model city for global urbanism (Charnock et al., 2019) and was ranked the second smart city in the world especially in energy and sustainability policies (Juniper Research, 2016). In 2014, the regional



government officially approved the SmartCatalonia strategy (SmartCat), seeking to elevate the smart city concept to a regional level and to innovate public services, among other purposes (Government of Catalonia, 2014). Second, the idea of citizen inclusion was explicitly emphasised in SmartCat, as part of a regional effort to promote a ‘more inclusive society’. The focus aligned with and was likely reinforced by the European Commission’s Horizon 2020 programme. It also took advantage of the existing regional innovation system in which citizens were already acknowledged as actors. In Barcelona particularly, the transition towards a citizen-focused smart city strategy was seen as a result of a political change in the municipality in 2015 (Charnock et al., 2019). Third, Catalonia possessed a large number of LLs and embedded the LL approach within its regional smart city and innovation strategy (Government of Catalonia, 2017). Catalonia is home to several of Spain’s and Europe’s first LLs as well as one-third of all Spanish LLs within the European Network of Living Labs (ENoLL). In 2017, the CatLabs programme was created under the dual direction of SmartCat and the regional innovation strategy (RIS3CAT). It sought to promote a regional network of existing LLs and other organisations that worked towards (digital) social innovation and smart city initiatives (Government of Catalonia, 2017). Overall, the scale and characteristics of LL activity in Catalonia promised a high rate of eligible cases.

Based on these criteria, seven LLs located in Catalonia’s urban areas were selected as cases, mapped in Fig. 2 with their names and acronyms. All the selected LLs explicitly expressed their commitment to engaging citizens and other actors in activities related to several urban sectors such as culture, ICT, and health and mobility. This commitment was articulated through their participation in either the ENoLL (six cases) or the regional CatLabs programme (six cases); five of the seven cases were part of both networks. ENoLL, a European movement established in 2006, accredits LL members via a two-round expert evaluation of the extent to which LLs empower citizens and users to participate in the innovation process (ENoLL, 2019; Mastelic et al., 2015). The CatLabs programme prioritises the involvement of LLs as organisations that work under a new open and collaborative structure of innovation and smart cities, such as the Quadruple Helix model (Government of Catalonia, 2017).

Although the selected LLs were participants of ENoLL and CatLabs, they maintained their autonomy and idiosyncrasies because their participation in these networks was voluntary. At the same time, regional policies and strategies neither established strong directions for

LLs nor ensured funding for all of them. The studied LLs’ working structures and outcomes were hence bound to the main organisations and various funders they collaborated with. The main lead organisations included municipalities and knowledge institutes (i.e. universities and research centres), while a typical funder was the European Commission, funding different schemes under fixed- and short-term projects, including pilot programmes.

Appendix 1 provides details about the year each LL was established, the sector or purpose of its activity, and other information about the main participating stakeholders.

### 3.1. Data collection and sources

Both primary and secondary data were collected (Appendix 2). At the end of 2017, a list of Spanish members was extracted from the ENoLL webpage, and seven LLs were located in Catalonia’s urban areas. We contacted these LLs and scheduled interviews with persons who understood and facilitated LL stakeholder engagement. All the LLs responded positively to participating in the research, although one LL described themselves as ‘inactive’ and was subsequently excluded from the research. During the data collection, an additional LL that actively participated in the CatLabs programme was added, leading to the total inclusion of seven LLs in this study.

The primary data for the analysis included 29 semi-structured interviews with 36 respondents, referred to as R1 to R36, as well as follow-up emails in some cases. The first round involved interviews with the LL management team and coordinators, defined as people explicitly dedicated (although not always full-time) to promoting LL activity. A snowball technique was employed to identify key Catalan LL stakeholders that represented all Quadruple Helix actors. Some stakeholders were familiar with and were connected to more than one of the research sites. Each interview lasted an average of 70 min. Although regional LLs are a small community, the respondents were diverse. They included key Quadruple Helix actors and provided sufficient information to address our research question.

In addition, for research purposes, one author was invited to observe and participate in several LL activities by interviewees who were organisers or active participants in these activities. Site visits were used for triangulation. Secondary sources included the LLs’ webpages and annual reports as well as other documents provided and recommended by interviewees.

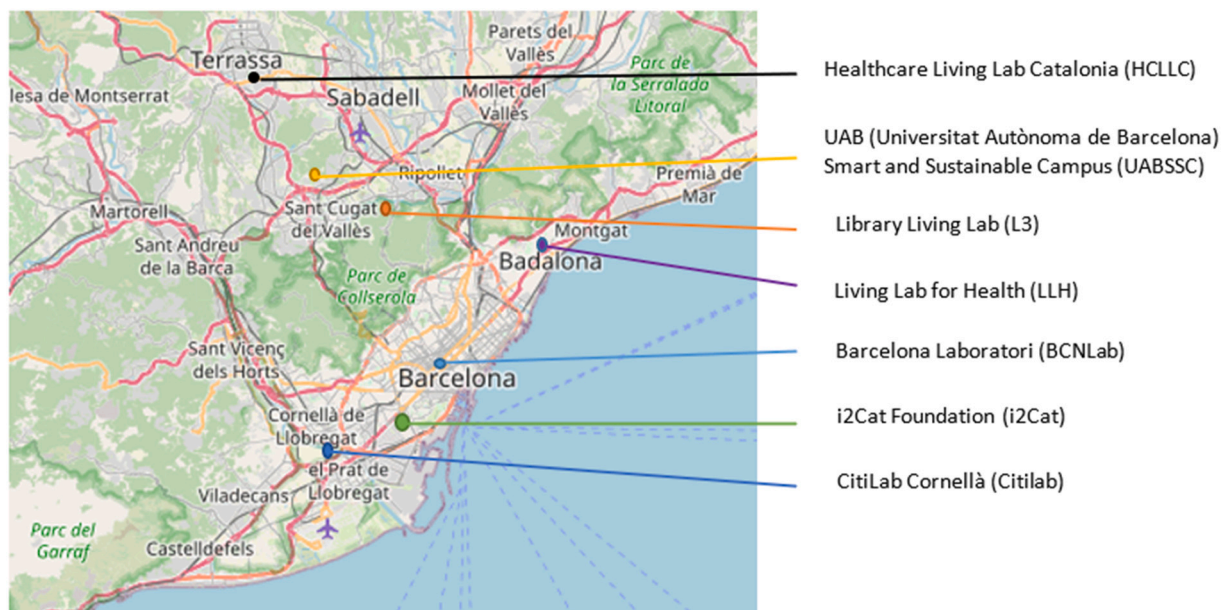


Fig. 2. Map of the studied Catalan Living Labs (Source: authors’ own design based on OpenStreetMap).

3.2. Data analysis

All interviews were recorded and transcribed except for two cases where interviewees preferred that only notes were taken. Thematic analysis (Braun and Clarke, 2006) was conducted with an abductive coding strategy (Ashworth et al., 2019; Linneberg and Korsgaard, 2019) using NVivo (12) software. While we embrace the inductive principle of building theory with a qualitative methodology (Bryman and Bell, 2011), we agree with Snape and Spencer (2003), who claim that this methodology involves both induction and deduction in which the data generation and interpretation are partially based on current theory. We adapted the thematic analysis in three steps: (i) categorising interviewees' narratives into codes; (ii) assigning these codes to sub-themes; and (iii) ultimately assigning these codes to broader themes that potentially address the research questions.

To fill research gaps, we explored how LLs included citizens in ways that changed power relations between citizens and other organisational participants. First, we identified the citizens' initial power sources by tracing back the reasons that LLs engaged with the citizens. Next, we deductively analysed LL operations based on the theoretical framework, considering how three characteristics of LLs might affect the power sources of citizens and their relationships with other stakeholders. During the process of assigning codes into themes, some interviewee narratives clearly conveyed the steps that LLs took, and we used these as guidelines for our analysis. The codes were accordingly re-organised into a common process shared by the seven cases. A final stage involved examining the impact of LLs on power relations, particularly citizens' perceptions of empowerment and other stakeholders' perspective on citizen input.

4. The case of the Catalan living labs

One common characteristic of the studied Catalan LLs is that they were launched by either governments or knowledge institutions initially dedicated to providing and mobilising operational resources, such as human capital and finance. Among other Quadruple Helix actors, the business sector was occasionally involved but lacked formal and critical contributions to LL activities. Citizens participating in the studied LLs were 'not a mass' but 'different collectives' (R4, management), which will be further explained. The flow of empirical data is depicted in Fig. 3.

4.1. Why engage citizens? Acknowledging citizens' power sources

In the interviews, the urge to include citizens in efforts to effectively respond to urban challenges was emphasised explicitly: 'The transition to a more inclusive approach to the notion of the smart city is not a luxury, but a pressing necessity' (R1, management). Two main power sources of citizens were identified. First, citizens had strong discursive legitimacy, justified by their rights, as made clear in three cases (BCNLab, Citilab, i2Cat):

You include citizens, not because they are going to buy the innovation, but because they have the right to innovate; because they have the right to be involved in the innovation that will impact society. (R9, management)

Citizens have access to this public technology, and they are participants; they can innovate without permission. This is permission-less innovation. (R8, management)

This approach also aimed to encourage and provide opportunities for everyone to innovate, pursuing increased social equality, especially because 'a growing number of citizens who feel left behind by the digital revolution are becoming disaffected' (R1, management). The same interviewee clarified as follows:

The benefits of the productivity increases brought by new digital products and services are not shared equally. [...] Because of these asymmetries, we are witnessing some reactions against digital technology, a kind of neo-Luddism which is often directed to applications such as Uber or Airbnb.

Furthermore, citizens were believed to possess critical resources or capabilities in all the case studies. Their most valued resource was their co-creation capabilities, especially enhanced in the Internet era, following a 'digital social innovation' notion whereby 'innovators, users and communities collaborate using digital technologies to co-create knowledge and solutions for a wide range of social needs, and at a scale and speed that was unimaginable before the rise of the Internet' (R1, management). Finally, most interviewees perceived the importance of engaging with citizens in delivering meaningful impacts specifically through their activities and generally in developing the region. Citizens' know-how as users was also a crucial capability for developing products that were 'useful for health' (R5, management) and to conduct research in a 'responsible manner' (R15, management). Additionally, citizens were residents and potential users whose behaviour changes could boost a 'healthy city' (R7, academic) and develop more 'sustainable mobility' (R13, management). This agency or capacity demonstrates that citizens possess the critical ability to advance urban change, since they are likely to be the most impactful type of actors.

These perceptions align with several community-based normative and policy concepts of European and regional research and innovation programmes mentioned by interviewees, including 'responsible research and innovation', 'open science', 'open innovation 2.0', 'citizen science' and 'Quadruple Helix'. These perceptions were also derived from the needs of some stakeholders, particularly governments and knowledge institutions, to address social changes arising from digital transformation or to meet institutional missions. A public authority indicated that 'digitalisation changes the ways of our learning, teaching, working, and manufacturing' (R17, government). Today, for example, few citizens use conventional public services (e.g. libraries, museums) because

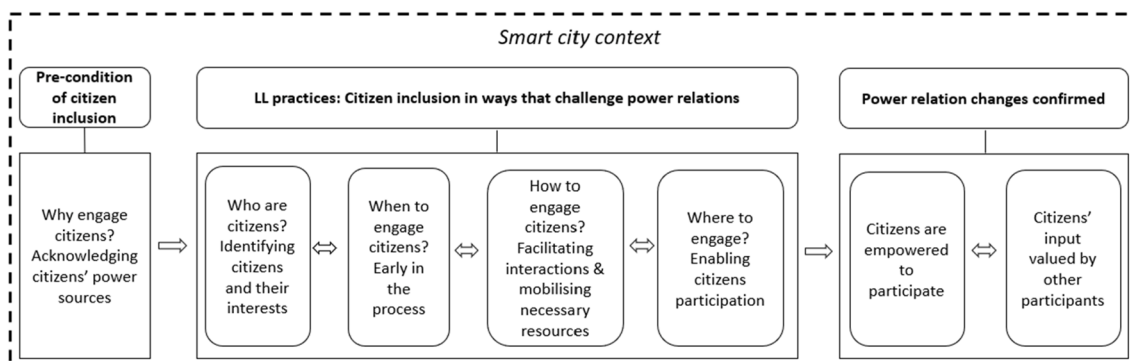


Fig. 3. A process for challenging and changing smart city power relations.

'young people don't need to go to libraries to find books, they can search for information on Internet' (R17, government). In turn, knowledge institutions wished to 'bring laboratories out of the research centre' (R11, management) and 'make an impact with university research in the territory' (R27, management).

#### 4.2. Who are citizens? Identifying citizens and their interests

Among interviewees, there was a major belief that citizens were independent actors who potentially brought their own insights into the ecosystem:

The approach that we always try to champion from Barcelona is the one we believe. It's more inclusive because you don't just try, let's say, to fix an old innovation system, in which you don't try to push citizens into [the interests of] Triple Helix, but you try to include them as they need.

(R9, management)

As addressed by several interviewees, it was thus imperative to identify target citizens and their interests:

The first step is to understand who they are, where they are, what they need to be involved in the projects, and the barriers they face. So, we focus on contacts, even defining them, mapping them like mapping other stakeholders from the ecosystem.

(R4, management)

We try to discover 'what is the community?', 'what are their interests?' and provide a tool to develop their own interests. We don't want to force citizens into our interests. This is our main concern. [...] First of all, listen to them.

(R24, management)

According to interviewees, citizens were distinct collectives contingent on each LL's focus, stakeholders' networks, project purposes and location. Citizens were a group of individuals who shared the same interests or CSOs that represented them, such as resident associations and patient associations.

Target citizens were classified into four main categories based on their interests in both personal and collective purposes. These interests were not static and could change over time. The first type included people who potentially desired to grow as entrepreneurs (e.g. professionals, such as artists, or open data community members). The second type referred to citizens wishing to pursue personal interests (e.g. library users, seniors). The third type included those who would like to improve living areas by identifying and attempting to address problems (e.g. education community: high school pupils and teachers, residents). The last group was people affected by, and willing to contribute to, specific projects (e.g. patients; university campus community: students and employees). For citizens outside CSOs, the LL activities transformed some of these sets of people into more socialised communities and groups.

#### 4.3. When to engage citizens? Early in the process

Although LLs aimed to include citizens in all phases, engaging them early was perceived as one of the ways that citizens were able to meaningfully shape choices about the innovation trajectory: 'We try to involve users from the beginning. That's the key point' (R13, management). 'Early' was interpreted in different ways: at the beginning of the LL's establishment or at the beginning of LL projects.

The earliest option of engagement was evident in two university-promoted LLs (L3, UABSSC), in which citizens shaped the LL establishment and purpose. L3 was 'rooted from the community' with significant influence from an association of residents who expressed their needs in the creation phase (R10, management). UABSSC organised a series of co-creation sessions in their extension phase that aimed to jointly 'define

the [LL's] structure, activities, management model and relations with the other services of the campus or with external projects' (co-creation invitation letter).

The engagement of citizens in later phases – that is, at the project level – was present in all cases. Some LL projects facilitated proactive citizen involvement in which citizens were given a degree of freedom in subject choice (Citilab, L3). Several interviewees reflected on this 'citizen-first' attitude, asking citizens, 'We begin with your interest. What do you want to do?' (R8, management). Some citizen groups (BCNLab, i2Cat, LLH) also suggested individual projects within larger, pre-defined themes, such as 'merging arts and technology' or 'mental health':

To have a clear visualisation of our communities, at the first stage, we did a co-creation process for two days and a half. Well, [it means that] inviting interdisciplinary profiles, we tried to co-design projects. Our main purpose was to structure the projects and then try to find resources to implement them.

(R1, management)

In some cases, citizens were engaged early in the working process to identify challenges and provide needs that were incorporated into the agendas of the other actors. This approach was notably observed in health and mobility projects (HCLLC, LLH, UABSSC). One interviewee clarified the following: 'Patients were involved at the beginning of the innovation part, but not in the design of the proposal and the design of the clinical trial. We included them partially, but we tried to include them [...] We enquired about their experience, how they did it, and what they wanted' (R7, academic). This effort was perceived as a 'new fashion [way of doing]' (R13, management), whereas 'in the past, patient involvement was so passive' (R7, academic).

#### 4.4. How to engage citizens? Facilitating interactions among stakeholders and mobilising necessary resources

##### 4.4.1. Co-creating

The LLs used various techniques to enrol citizens and elicit their input in ways that could steer new and ongoing projects and promote interactions among diverse participants in an open environment. The techniques were largely grouped under the 'co-creation' umbrella, sometimes also referred as the 'participatory' or 'co-designing' methodology by interviewees. These techniques were facilitated by either LL coordinators or external co-creating professionals. Co-creation was used for short-term projects, such as a mental health project, or one-off intensive events, such as workshops, panel sessions and hackathons. There were two main directions: co-creation in groups of diverse stakeholders, irrespective of their sectors, and co-creation among participants of the same sector (e.g. only citizens).

The first direction directly endowed citizens with agency and was adopted in most of the LL projects because of its 'openness' (R16, academic) and its value for holistically understanding and tackling the issues: 'In my experience, it is always very useful, and people, for the first session only, were very satisfied. This is a challenge, but if you do some design thinking or have technical dynamics for people to interreact with, you break barriers, and people open up' (R13, management). The 'challenge' this interviewee mentioned refers to different languages, different purposes and previous misconceptions among different types of participants.

This challenge motivated one case LL in the health sector (LLH) to move from the first direction into the second – that is, towards single sector co-creation – in their latest project:

People will talk freely without power relationships. It will be easier, and the power or knowledge of the group will be similar, so the conversation will come up more freely. In practice, what we do is organise separate workshops, one with experts from academia and one with representatives of the CSO.

(R15, management)

This illustrates the effort to overcome the challenges of trust, confidentiality and knowledge gaps between citizens and other groups, especially in the health sector and in some other projects involving general citizens. Likewise, Citilab ‘tried to lower the bar’ in terms of co-creation topics, ‘so citizens got into the project’ (R4, management). Indeed, one of the reasons citizens declined to participate was that ‘the topic was not exactly something [they] knew about’ (R23, academic), according to several interviewees.

#### 4.4.2. Enrolling citizens in projects (citizen-led vs. professional-led)

Citizens participated in two main types of projects: citizen-led or professional-led; both could exist in the same LL. In the first type, citizens worked on their own issues and were granted the autonomy to lead projects with various resources, such as funds and advice, provided by LLs; these efforts were sometimes positioned within the framework of European projects. In the latter type, ‘researchers had specific projects – for example, within the H2020 programme, or SMEs [small and medium enterprises] proposed experiments’ (R14, management).

The first type of project was observed most evidently in BCNLab projects, where, after co-creation sessions, citizens were provided with critical resources to undertake activities with visible outcomes. An open call was made for entrepreneurial activities, and then the responses were matched with available funding and consulting from the public sector. Other projects produced open-sourced products for public purposes or solutions to identified problems (Citilab, L3, LLH), where spaces, tools and academic consultations were facilitated by LLs. Citizens exerted leadership roles in these short- or long-term activities and reached some degree of formal authority within their projects. For example, the academic who worked with education communities confirmed that ‘students decided everything’ (R16, academic).

Some professional-led projects also ‘put citizens, as much as [they could], in the centre of the process’ (R4, management). Citizens played different roles, such as improving the operations of other actors by testing applications or providing feedback on prototypes to technicians, SMEs or researchers. These activities appeared in the early stage of the LLs, when UABSSC ‘did not have a strong LL methodology yet’ (R14, management) or HCLLC ‘had not yet received official funding’ (R6, management). The main purpose was to ‘make an efficient use of the existing resources, but in a collaborative manner’ (R14, management), based on their existing industry contacts, research programmes and funding. The same happened in i2Cat, before the establishment of the LL unit in 2015, when the LL activities were integrated into research and innovation projects: ‘It was technological in nature, and the LL participation in these projects was constrained to basically testing the prototypes with the user, managing the user interaction and user feedback, and the real-life qualification of these platforms’ (R9, management).

Thus, it was clear that available resources and stakeholder goodwill in LLs affected the ways citizens participated. On the one hand, LLs did not expect financial returns, a fact confirmed by most interviewees in all cases, although some recognised that citizen inclusion might open funding opportunities: ‘We are building a new concept for projects, and the benefit is clear because some European funds [prioritise] this line [of projects]. This benefit is direct for the stakeholders because they have the possibility to access the funding from projects’ (R5, management). On the other hand, it was very difficult to organise citizen projects if they were not within funded research and innovation frameworks, especially when LLs did not have sustainable funding to maintain operations. The operations required a ‘sustainable model’, where ‘you don’t have to open any budget to feed it’ (R11, management).

#### 4.4.3. Co-opting citizens in governance

Citizens played the role of governors in only one case (L3) by means of an association of neighbourhood residents. This was because this CSO, together with the support of a research centre, had initially mobilised to demand the municipality provide the neighbourhood with an innovation location. The CSO then became involved in co-governance of the LL,

specifically leading its communication strategy. The CSO was endowed with formal authority to shape the direction of the LL operation.

Offering this formal authority to civil society was not realised in the remaining cases, although several interviewees spoke positively about the example:

We have 8,000 members of Citilab. But we still don’t have anybody that represents the Citilabers in the board of the Citilab; it is something to do. These people can influence the orientation of the Citilab directly, not only orientation of their owned project, but the orientation of the whole foundation.

(R8, management)

This realisation requires, on the one side, the capability and commitment of civil society, and, on the other side, the willingness of all stakeholders – or at least the ones with pre-existing formal authority. One interviewee hesitated about the possibility of co-opting civil society in the governance board at the current stage, arguing the following:

Users’ participation is important, but board members have different roles, completely different. They are people who have connections, have a professional entrance in developing whatever we do, to answer the needs of users. [...] And now patient associations are not very organised. [...] Also, this is a new kind of project, new concept for stakeholders, so it’s hard and difficult.

(R5, management)

Nonetheless, the same person conveyed a prospect: ‘But in the future maybe, if we have strong patient associations, maybe we invite them to participate in the board, why not? The LL is not in a closed structure; it is open’.

In contrast, other respondents offered different views on CSOs in Catalonia generally and in the health sector particularly, noting that ‘they are very active’ (R15, management), and ‘there are a lot of associations. They are well organised, they provide a lot of services to patients, and patients are really linked to them. It’s not only a lobby [influencing politicians]. There are clinicians there, also; they sometimes work as [service] providers’ (R7, academic). Accordingly, some interviewees acknowledged the right or capacity for citizens to be involved in LL governance: ‘Citizens should be involved. They have resources and experts. It depends on what you think when you say ‘society’, but it’s organised. For example, neighbourhoods have their associations. And they are very active, and they have some money; they can also support some initiatives’ (R23, academic).

Governance boards with that include civil society were perceived as possible because ‘there is no political blocked mindset to say: ‘No, you cannot participate’’. However, the following reality was acknowledged:

This is a slow process [...] You can invite them, but people say, ‘No, I am an NGO dealing with social issues, why should I innovate – what is that?’ This is a process to understand that innovation is an issue for everyone. It is not a business for the private sector or university. Everyone should be involved in innovation in some way.

(R8, management)

#### 4.5. Where to engage? Enabling citizen participation

From 2017 to early 2019, LL operations were both virtual (R6, management) and physical. As explained by several interviewees, virtual networks meant that there were LL activities and projects implemented that involved different stakeholders, yet the project team had no fixed space or otherwise considered the whole city and university campus as an LL workspace. Three cases operated in virtual environments by the time of the data collection (BCNLab, HCLLC, UABSSC) but were in the process of establishing physical spaces. Among those cases, BCNLab had worked to ‘shape the concept of the city laboratory’, referring to the ‘city as an ecosystem of experimentation and co-

creation' among Quadruple Helix actors (R1, management). UABSSC sought to 'explore the possibilities of the network', where they 'made connections' virtually with different stakeholders to initiate and implement LL projects (R30, management).

A physical place was necessary to organise activities and improve citizen participation by providing an open space for citizens to come on a daily basis and propose their ideas while optimising public infrastructures. Five of the LLs were integrated into public spaces, including the local public library (L3), university libraries (UABSSC), an art factory (BCNLab), and technological and research centres (HCLLC, Citilab). The remaining cases operated in certain locations on a project basis (i2Cat, LLH), mainly utilising public infrastructures. LLH used places it considered to be 'neutral' locations (R15, management) for all participants in terms of distance and discipline, depending on the project (e.g. a science museum for a science education project). It is worth noting that this multiple-case study was carried out before the COVID-19 pandemic and, therefore, any changes in organising citizen participation (i.e. virtual vs. physical) due to the pandemic were not observed.

#### 4.6. LLs changing power relations

Based on the outcomes of some LL projects, evidence suggested that power relations between citizens, governments and knowledge institutions had changed. Citizens were motivated to participate in LL activities, while academics and public authorities confirmed the positive dynamics resulting from citizen input. The connections with industry were not very well observed because of their inconsistent presence, but the innovation managers we interviewed indicated that the interests of industry in citizen inclusion appeared to be for 'business-as-usual' purposes of innovation exploitation, noting that 'doing real-life tests is something important' for product development (R31, industry) and innovation exploration, including 'entrepreneurial idea discovery' (R32, industry).

##### 4.6.1. Citizen power: their self-perception

With the support of LLs, some citizens were motivated and enabled to achieve their initial goals. One citizen appreciated the regional pilot efforts to promote the active participation of other citizens, noting that 'we need to teach the citizens how to be able to solve problems by themselves' (R22, citizen). An academic confirmed the impact of LL activities in enabling citizens to address their problems: 'Students presented the results of their research to the director of the school, and the school made some changes. For them, it was very interesting, and it had a real impact in the moment' (R16, academic). An interviewed entrepreneur shared the value of the LL network: 'We have the city council as a client, as well as the regional government. We are exploring the university side and then the companies because we think that it makes sense for companies to have this digital channel for the community. But at this moment, companies are not valuing it so much' (R2).

Interestingly, during the LL process, some local residents went beyond their initial personal interests and genuinely wanted to promote regional development by inviting industry to participate. This demonstrated the complexity of power where it was not always perceived as a 'zero-sum game' among actors but could be a collective effort to address common problems. One interviewee suggested, "We need someone to go to company A and speak to someone: 'We have this LL, and we want to collaborate – what can we do?' Here, we have a lot of big companies. [...] The more people we have here, the more interesting it is" (R33, residents).

##### 4.6.2. Citizen power: perceived by other stakeholders

Citizen input was positively valued among governments and knowledge institutions, and a change in the citizen inclusion method was observed: 'It is interesting seeing how the discourse about how the smart city should look has affected the agenda of the government itself' (R20, industry). In the case of knowledge institutions, both management

and researchers considered the positive aspects of citizen engagement for education and research purposes:

The LL can be the first step to new ways of teaching, new ways of interacting among teachers, students, and companies and researchers.

(R27, management)

Before participating in the LL, all the projects I had were only [some interviews] for research. But in the last few years, as the European Commission also promotes this, I try to incorporate this method, that needs to work with the community in the whole process of the project and with the LL.

(R16, Academic)

Academics were motivated to engage with citizens because of the derived benefits especially from learning opportunities, yet in some cases they needed institutional support to do so. While these initiatives were better valued by universities, academics faced challenges related to time and opportunity cost as they worked to meet different expectations. Academics thus 'have to look for the balance' (R16, academic).

##### 4.6.3. The role of coordinators in changing power relations

A crucial role of LL coordinators, if not the most important one, was to stimulate stakeholder commitment, especially from citizens. Citizen commitment refers to the willingness of citizens to participate in the LL and exercise their power. In five of the seven cases, the LL employed full-time coordinators at the time of the enquiry; during the course of the research, two other LLs also introduced this position. L3 acknowledged the need for a coordinator and was in the process of recruiting: 'Until now, the persons in charge of the LL are A or B; both are teachers and researchers from the university. They have no time to do that. [...] It is very difficult if you go to the LL but it is closed because A is in class and B is at a conference' (R30, management).

In L3, individual citizens who had their representative, a CSO, on the governance board considered their governance board something that was 'highly political' (R34, resident). When they had concerns, they preferred to reach out to someone who coordinated their daily activities: 'The most important change [we would like] is to have someone here who we can speak to, or someone who organises courses and spends time here' (R34, resident). Having a dedicated person to address citizens' needs and reinforce trust was also a common theme: 'They can express more things they would like to change when they have some space and some reference persons to talk with. I think it is the key' (R21, NGO).

The LL coordinators bridged citizens and different stakeholders. In some cases, they helped citizens overcome their hesitation to directly contact other actors: 'The interesting thing here is that I do not need to be concerned about politics, that I am related to this public thing. I work with C [LL coordinator], who is channelling us to projects and events' (R2, entrepreneur).

## 5. Discussion: how do living labs include citizens in ways that change power relations?

A common finding across the studied cases was the presence of LL actors who acknowledged the agency of citizens in collaborative ecosystems. These actors, especially LL coordinators, were closely aligned with the interests of relevant citizens and keen to involve them in various ways in different projects. This offered what might be considered a 'temporary' or 'borrowed' power position within LL collaborations, justified mainly by the discursive legitimacy of citizens and the critical need for their participation. When citizens were able to successfully leverage this initial power change, these closely aligned actors were able to once more 'lend' power positions to citizens to allow them to acquire critical resources through access to project funding and contacts. In these cases, citizens secured either their autonomy to lead projects and achieve goals or their formal authority through



participation in formal governance structures. In the latter situation, citizens were able to be formally involved and constructively contribute to the governance of the collaborations. This constitutes what we call a ‘power banking’ mechanism in which the power lending roles were mainly played by the coordinators funded by either governments or knowledge institutions.

The power banking mechanism includes two key self-reinforcing elements facilitating the power transfer process. The first element is citizens’ willingness to borrow power and to use it productively to leverage their initial power sources. The second is the power bankers’ commitment to reserving their own discursive legitimacy, critical resources and formal authority to better incorporate citizens into activities with other actors. Presenting our findings and discussion, Fig. 4 visualises the overall mechanism by which intermediaries such as LLs may organise the inclusion and empowerment of citizens in collaborative ecosystems.

A few studies in the collaboration literature have identified LLs as boundary spanners seeking to bridge various sectors (Van Geenhuizen, 2018) or LL coordinators as individuals who nurture the relationships among different actors (Palomo-Navarro and Navío-Marco, 2018). When it comes to citizen inclusion, the role of LL coordinators conventionally involves collecting and organising information provided by citizens, as users, and forwarding it to other Triple Helix actors (Nyström et al., 2014). Our analysis contributes to this discussion by illustrating a fundamental change in contemporary urban collaborative discourses and practices that are interested in exploring the agency of citizens in innovation and their likely undermined roles. In this context, power bankers are the focal actors who build trust, empower individual citizens to identify their desires, and effectively incorporate citizens into the collaborations as independent actors.

We acknowledge that organising collaborative systems requires the efforts of many individuals and organisations, rather than ‘a single heroic agency’ (Breznitz et al., 2018, p. 894). While our findings suggest that power bankers are central to challenging and changing smart city power relations in favour of citizens, several factors are critical for this endeavour to be sustained or scaled.

First, the existence of power bankers – a role exercised by LL coordinators – is largely contingent upon political and social support, as public funding was crucial to filling this role in most of the cases. The discursive legitimacy of citizens, perceived as their right to be involved in the system, especially in digital era, was primarily addressed by governmental actors first. This call was later echoed by knowledge institutions in the form of European community-based policy concepts,

including several funding opportunities. Citizen inclusion in collaborative ecosystems seeking to ‘democratise innovation’ then became a learning process supported by public funding or included in funded research and innovation projects. If this had not been the case, according to our interviewees, then such collaboration would not have been possible. This points to the perceived emergent challenge of maintaining LL operations (Rizzo et al., 2021), a condition for power banking to function.

Second, although the voices and interests of citizens are better valued by participants in LL contexts, incentives are critical to maintain participants’ commitment (Weaver, 2014). Citizens may also feel an incentive to participate in LLs if they expect to obtain outputs from the collaborations. However, the expected outputs are vague and uncertain, considering the long process. In contrast, the cost of participation is clearer and observable, especially as regards the time investment. The feeble incentives and cost requirements raise important challenges in the effort to engage and retain citizens and other stakeholders, since the collaboration is voluntary (Nguyen and Marques, 2021). LLs or participating organisations would need to address the issue of incentives to enable changes in power relation at a structural level. Doing so would require either LLs to align the outcomes to the needs of each participant or Triple Helix organisations to allow citizen engagement activities to be recognised and best utilised at the institutional level.

In this regard, we note that the simple act of meaningfully involving citizens in ways that allow them to participate as equivalent (not even equal) actors to the other established organisational actors in these experimental ecosystems is extremely complex. The proposed mechanism involves enthusiastic coordinators who repeatedly provide power to citizens, a role justified by citizens’ discursive legitimacy, so citizens can leverage that loaned power to create new power sources. This illustrates the challenge of the problem: it is not a trivial task to meaningfully involve citizens when the extant collaborations consistently marginalise and exclude citizen power. This suggests that we should be more critical with the calls for using the Quadruple Helix model to improve the quality of governance and decision-making. Primarily, we should focus on the mechanisms through which power can be ‘lent’ to civic actors to facilitate their exercise of agency.

As an additional challenge, although citizen inclusion is a precondition for leveraging citizens’ capacity for innovation from a democratic perspective, their inclusion does not necessarily imply that collaborative projects are strategically successful. Even if Quadruple Helix collaboration takes place, satisfactory outcomes for all participants are difficult and endanger the continuation of the collaboration (Nguyen and

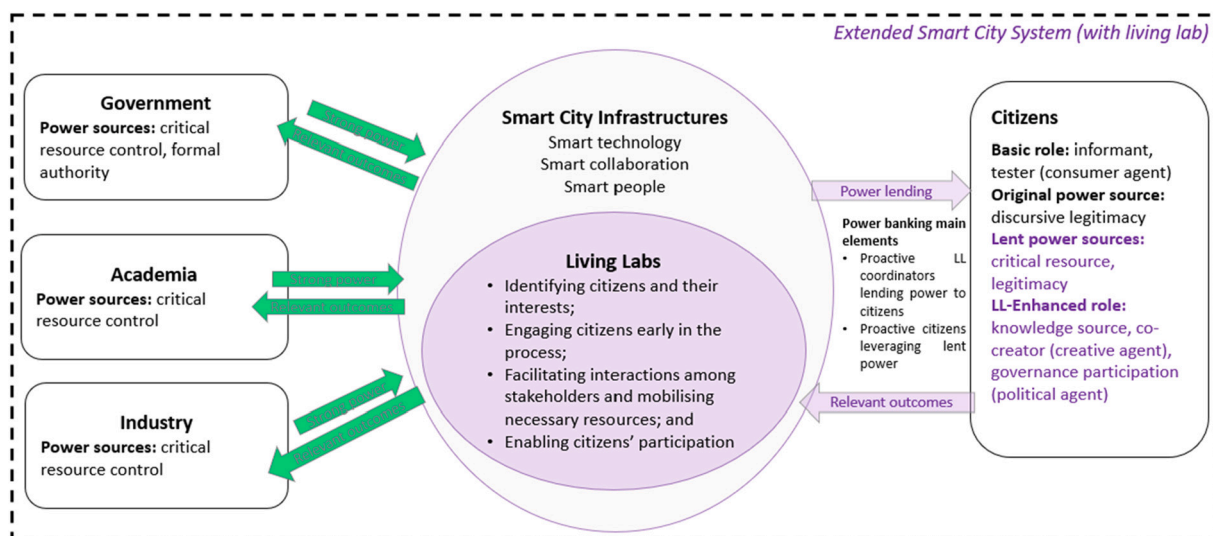


Fig. 4. Citizens' power and inclusion in smart city systems with intermediaries (LLs).

Marques, 2021).

5.1. Theoretical and empirical contributions

Our findings contribute to the contemporary discussion on citizen inclusion in collaborative ecosystems by providing a process and mechanism, foregrounded by the theory of power, to meaningfully include citizens. By doing so, we make three contributions.

First, we address a major concern from several scholars about the vagueness of the terms ‘citizens’ and ‘civil society’ and their ontology in the context of including citizens in collaborative systems (Avelino and Wittmayer, 2016; Engelbert et al., 2019). Our findings highlight the primary importance of detecting citizens and their interests and uncovering different types of citizens according to their interests. Second, we underline that differential interests and power sources require different strategies and incentives when it comes to engaging different types of citizens, both in term of power relations and democratic representation. For example, this can be observed in the different directions of co-creation adopted in our case studies with the aim of facilitating citizen contributions. Some co-creation activities, such as the hackathon, attracted ‘disproportionately young and tech-savvy’ participants. Several interviewees were aware that different strategies would have needed to be implemented to if the goal had been ‘to reach out to senior citizens or people from socially disadvantaged neighbourhoods’. As per our interviewee, ‘This is especially important to avoid the pitfall of a well-intentioned public policy actually ending up increasing the digital gap between the capability-rich and the capability-poor’ (R1, management). This issue is extremely relevant in debates related to the booming co-creation literature as a methodology to create an open environment for societal transformation. Failing to recognise power asymmetry in these activities in practice leads to negative consequences, as recently proposed in several conceptual studies (Turnhout et al., 2020). Some critics also importantly note that that co-creation and other participatory methods should not be a means for public authorities to elude their responsibilities (Hertting and Kugelberg, 2018). Third, the capability to influence decision-making and change may encourage citizen engagement, as suggested by current theory and policy discourses. That said, the evidence indicates that, at the time of this study, formal authority in the form of representative co-governance appears uncorrelated with individual citizens’ motivation to participate. However, gaining the autonomy to identify and address their problems seems to generate immediate effects on citizen empowerment.

6. Conclusions

This paper addresses the contemporary interest in citizen inclusion in smart city collaborative ecosystems to effectively address urban problems. It contends that there is a need to address the existing power imbalances in which institutionalised norms and the relationships between classic actors tend to frame citizens as passive consumers and prevent them from exerting power. We analysed how LLs challenge and change those power relations at the micro-scale and could potentially form the basis for a broader shift at the structural level of urban collaborative systems. Applying power theory, the success of power relation change is

contingent upon two interrelated elements. On the one hand, citizens must be empowered to exercise their power sources and to influence the decision-making process. On the other hand, the strong ties between Triple Helix participants must be challenged: the actors must be better attuned to citizen voices and recognise the value of citizen input.

This paper presents an exploratory case study of seven LLs in a single region renowned for its social practices and relatively high levels of social cohesion. Our results suggest that a self-reinforcing mechanism that agencies exert through ‘power bankers’, coupled with factors such as political support and incentives, endows citizens with temporary positions of power. Citizens may leverage this power in smart city activities to deploy means, such as access to critical resources and (potentially) formal authority, to achieve their goals. The identified mechanism appears to be strongly reliant on publicly funded coordinators, who are unlikely to be present in all contexts. Although other mechanisms may occur, these findings may apply generally, thereby justifying a sceptical attitude towards the Quadruple Helix model. The efforts required to engage citizens at a basic level in a socially active region suggest that, in less social regions, it could be even harder to mobilise citizens to build smart cities. It would be valuable to have similar studies in other settings to compare and verify our findings and arguments.

This research is subject to two main limitations that future research could address. First, access to citizen interviewees was relatively limited; future interviews could uncover more nuances in citizen perceptions. Further research that offers broader citizen insights would be beneficial, although this issue may be difficult to overcome due to the dispersion of citizens. Second, this study examined LLs as a potential instrument for citizen inclusion to expand the problem-solving capacity of smart cities. The effect of LLs on democracy should be subject to deeper examination.

Funding

This work was supported by the European Union’s Horizon 2020 Research and Innovation programme [grant number 722295]; and the Ministerio de Economía, Industria y Competitividad [grant number ECO2017-86054-C3-3-R]. The research reflected only the authors’ view, and the funders are not responsible for any use that may be made of the information it contains.

Declaration of competing interest

None.

Acknowledgments

The authors would like to thank all interviewees for sharing valuable insights and facilitating the fieldwork. We are also grateful to three anonymous reviewers for their constructive comments. Lastly, this article has been published on behalf of our late co-author, Paul Benneworth, and in his memory. The excellent contribution of Paul is acknowledged and his firm belief on the value of this research has inspired us to continue this work.

Appendices

Appendix 1

Main characteristics of cases.

Case	Est. year	Sector	Purposes relevant to LLs	Lead stakeholders
BCNLab	2012	Culture and technology	To combine traditional arts, science and technology; to support both existing initiatives and new entrepreneurial proposals.	Promoted by the Directorate of Creativity and Innovation within the Culture Institute of Barcelona (Barcelona City Council).

(continued on next page)

Appendix 1 (continued)

Case	Est. year	Sector	Purposes relevant to LLs	Lead stakeholders
L3	2015	Culture and technology	To create links between culture, technology and society; to explore how technology can transform users' experience into new services and applications.	Located in a public library. Governed by Computer Vision Centre (a research centre of UAB), UAB, the Sant Cugat municipality and the Volpelleres Association of Residents.
HCLLC	2016	Health	To provide administrative infrastructure, management and a 'laboratory of ideas'.	Governed by long-standing LEITAT technological centre.
LLH	2014	Health	To promote health for and with society through educational and participatory programmes that empower citizens with the knowledge to make decisions about health and to engage in health research and innovation projects.	Developed from the Terrassa municipality's innovation platform. Governed by IrsiCaixa AIDS, a private research centre promoted by a bank and regional government.
Citilab	2007	ICT	To democratise innovation and promote a knowledge society through use of the Internet and a collaborative learning environment based on design thinking, computational thinking and user-centred co-creation.	Established by the Cornellà municipality. First citizen centre in Catalonia for social and digital innovation. Serves as a training centre, research centre and business and social incubator.
i2Cat	2002	ICT	To foster collaboration and empower citizens through open and participative digital social innovation.	Non-profit research and innovation centre, with a separate LL unit established in 2015. Promoted by the regional government. Pioneer of the Catalan LLs, founding member of the ENoLL. Consulted for the creation of other Catalan LLs.
UABSSC	2014	Mobility (and extending to other areas)	To assist the university in research, technology transfer and societal interaction by considering the university as a city LL that combines smart city technology with social innovation and actively engages end users.	Established by the UAB, Catalonia's second largest university. Part of the CORE strategic research communities at UAB.

Appendix 2

Data sources.

	BCNLab	L3	HCLLC	LLH	Citilab	i2Cat	UABSSC
No. interviews	5	12	2	3	3	8	6
No. interviewees	5	17	3	3	3	8	6
Out of which ...							
LL management and coordination	2	5	2	1	2	3	4
Government	1	3		1		2	1
Academia	1	3	1	1			1
Industry		2				1	
Citizens	1 (Entrepreneur)	4 (Residents who participated in trainings)				2 (NGO & citizen)	
Observations and participations	Workshop on innovation programmes and projects (01/2018)	Public debate on artificial intelligence (01/2019)	Hospital visits (12/2017 & 02/2018)	Hospital and public health centre visit (12/2017)	Citizen co-working space visit (12/2017)		Co-creation workshop, opening day (02/2018)
	- Site visits (2017–2018)						
	- Day of open innovation and fab LLs in Catalonia (CatLabs, 02/2018)						
	- Open LL Days (ENoLL, 08/2018)						
Secondary data	Webpage, emails, presentation, LL introduction	Case studies, webpage, presentations, leaflets	Webpage	Webpage	Case studies, annual reports, webpage	Case studies, annual reports, webpage	Case studies, webpage, LL extension plan
	- Presentations and working papers on regional LL strategies						
	- ENoLL webpage and members' profiles						

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