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The City of Digital Social Innovators

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Editorial

The City of Digital Social Innovators

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Abstract
The concept of digital social innovation (DSI) refers to a fast-growing set of initiatives aimed at providing innovative solutions to social problems and needs by deploying the potential of the social web and digital media. Despite having been often interpreted as synonymous with digitally enhanced social innovation, we explain here why, in consideration of its epistemological and socio-political potentialities, we understand it as an interdisciplinary set of practices able to interpret and support the changes of a society that is more and more intrinsically virtual and physical at the same time. Notably, we briefly discuss how DSI processes can be functionally mobilized in support of different socio-political projects, ranging from the mainstream neoliberal to the revolutionary ones. Eventually, we provide a synopsis of the articles included in this thematic issue, by aggregating them accordingly to the main stakeholders promoting the DSI projects, being more bottom-up oriented or more institutional-based.

Keywords
digital social innovation; digital turn; urban governance; urban planning

Issue
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1. Introduction

Social innovation has always had a crucial role in promoting progressive development in society (Busacca, 2013; Moulaert, MacCallum, Mehmood, & Hamdouch, 2013). With the advent of the digital age and the transition of a large part of our social lives (and private lives) to the internet, the space for social agency has expanded well beyond the physical domain (Ash, Kitchin, & Leszczynski, 2018; Castells, 1996; de Cindio & Aurigi, 2008). Today, it is widely recognised that the digital revolution offers new opportunities for the social agency to operate innovative interventions, notably concerning the structure and functioning of contemporary cities (Gairola & Roth, 2019; Graham, Zook, & Boulton, 2013). At the same time, it opens up new challenges such as misinformation (Flynn, Nyhan, & Reifler, 2017) and digital divide among different social groups and among territories which add to already existing disparities (Mossberger, Tolbert, & McNeal, 2007). By stepping beyond the acritical technology-optimism of the smart innovation perspective (Aitamurto, 2012; Prahalad & Ramaswamy, 2004) and buying into some of the radical analysis of digital capitalist discontents (Lanier, 2006; Herzog & Hartwig, 2008), contributions collected in this thematic issue explore how traditional planning and governance processes are challenged by the agency of digital social innovators.

It is increasingly evident that the movement of digital innovators, hackers, makers, social entrepreneurs, open access promoters, and cyber activists is advancing new ways of organising and equipping the city to im-

prove people's livelihood and liveability in terms of education and job, political participation, science and technology, economy and business, housing, public space design, and public services provision (Caulier-Grice, Davies, Patrick, & Norman, 2012; Dyer et al., 2019). The mushrooming of innovative solutions to social problems bootstrapped by the advent of the social web and digital media (Bria, 2015) provides new opportunities for direct participation practices emerging in different segments of the European societies. However, opportunities are not necessarily balanced or equal. On the one hand, participative approaches are increasingly seen as a condition for promoting democracy, able to guarantee fairer access to goods and opportunities, and associated with ideals of accessibility, transparency, and engagement (Dyer, Gleeson, Ögmundadottir, Ballantyne, & Bolving, 2017; Gleeson, Dyer, & Grey, 2017). Yet, on the other hand, the diffusion of these very practices is not homogeneous among countries and regions and their capability of scaling up from pilot experiences to systematic changes is still under investigation (Moore, Riddell, & Vocisano, 2015; Westley, Antadze, Riddell, Robinson, & Geobey, 2014).

2. Different Approaches to Digital Social Innovation

Traditional research on social innovation has hardly acknowledged that the digital turn, further than equipping existing processes with more robust communication and organisational tools, radically transforms the socially constructed nature of tackled problems, the choice of which problems are worthy of support, the construction of knowledge about them, and their ethical impacts (Lawrence, Dover, & Gallagher, 2014). While digital social innovation (DSI) has been, in fact, initially regarded as a form of social innovation triggered, empowered, mediated, or even transformed by the use of digital technologies (Boelman & Heales, 2015; Howaldt & Schwarz, 2016; Millard & Carpenter, 2014; TEPSIE, 2014), we claim it is something more. DSI is, actually, producing epistemological (i.e., how people come to define, know, and operate on reality) and political changes (i.e., how people modify the meaning, forms, and ends of governance processes) that call for a critical approach to interpret the transformations of both society and technology landscape. Therefore, in this thematic issue, we do not refer to DSI as synonymous with digitally enhanced social innovation (which is, of course, a desirable and relevant part of the phenomenon); we rather prefer to see it as an interdisciplinary set of practices able to interpret and support the changes of a society which is more and more intrinsically virtual and physical at the same time.

Such a vision is well illustrated by many of the projects financed by the European Commission under the Collective Awareness Platforms for Sustainability and Social Innovation (CAPS) program. CAPS' definition has been introduced in 2012, in the context of the Seventh Framework Programme of research, to identify an emergent group of projects and, to a certain extent, a new research area (Passani, Spagnoli, Bellini, Prampolini, & Firus, 2015). Indeed, "Collaborative Awareness Platforms can be seen as ICT-supported collaborations of human and non-human actors which enable and facilitate the production, sharing and sense-making of information gathered through citizen engagement and through sensors and the like" (Arniani et al., 2014). Key aspects of the projects financed in that domain have been the strong engagement of citizens, the focus on pressing social or environmental issues, and a strong interdisciplinary effort. It is not by chance that some of the projects that concurred to the emergence of the term DSI have been financed by this program. Hence, we prefer the term DSI to others such as 'tech for social good' and 'civic tech' because it can really put the social and the technical dimensions of innovation on the same level, and it can call for a truly interdisciplinary and citizen-centred way of addressing societal issues.

Of course, it is also important to acknowledge that there are different forms of DSI, ranging from those functional to the reproduction of the status quo to those subverting it—including a vast array of nuances in between (Maglavera, Niavis, Moutsinas, Passani, & De Rosa, 2019). We find DSI initiatives intended to make existing socio-political and economic processes faster, more efficient, or effective without inducing any change in the structure of society or in its understanding. Smoothly integrated into the smart city rationality, these initiatives are often supported or, sometimes, co-opted by the neo-liberal institutions (e.g., Microsoft Civic Tech; Spicknall, 2018). A slightly more inclusive, participatory, and people-friendly approach characterizes DSI initiatives advanced by CSOs and public administrations and promotes the establishment of collaborative platforming and bring citizens to cooperate with institutions (e.g., Nesta, 2020). Proceeding along an imaginary line between mainstream and revolutionary processes, we can identify a reformist approach in DSI projects that aim at directly intervening and transforming the urban sociospatial structure and its functioning by deploying the potential of existing digital technologies and leveraging on their co-creative and pervasive potentiality (Certomà, Rizzi, & Corsini, 2015). These include, for instance, initiatives aimed at making migrant people emerging from invisibility by learning the local language (e.g., Speak, 2020) and providing mutual aid (e.g., Mosquera, 2020). While some of them use proprietorial technologies (e.g., Fixmystreet, 2020), other couple their social commitment with concerns for the ethical software development and adopt open access and open source technologies (e.g., Smart Citizen Kit; Smart Citizen, 2020). Eventually, we identify DSI initiatives advanced by cyberactivists, hackers, and makers with the explicit intention to revolutionising technology rules and tools. In so doing, they move the social struggle in the digital space battleground. They fight to promote people's digital sovereignty over their data (e.g., Lleialtat, 2020), access

to the web through community-owned network infrastructures (e.g., Guifi, 2020; Ind.ie, 2020), and the possibility for self-fabrications of technological tools (e.g., Arduino, 2020). By following up one of the key intuitions of the fathers of digital revolutions—i.e., that we can only change society by changing the tools it uses (Cadwalladr, 2013)—revolutionary DSI initiatives invent, hack, boycott, and transform the technologies of everyday life, to contrast the massive fluxes of the economic, financial, material, and symbolic power of digital capitalism (Coleman, 2015; Zuboff, 2019). Critical scholars and internet activists involved in revolutionary DSI initiatives raise doubts about the potentialities of DSI to foster real participation in governance and to serve public good because these contain "both utopian and dystopian possibilities for new forms of sovereignty" (Thompson, 2018, p. 1178). Main criticalities resided in the transformation of participation meaning and practices (Baccarne, Mechant, Schuurman, Colpaert, & De Marez, 2014); the capability and possibility to govern DSI in the emergent public-private governance regimes; and the changes in power geometries and empowerment mechanisms induced by the digital turn (Bendiek, Godehardt, & Shulze, 2019; Parayil, 2005).

3. Synopsis of the Thematic Issue

The collection of articles presented in this thematic issue provides an intriguing spectrum of perspectives about the emergence of DSI as either a top-down driven or a grassroots bottom-up initiative located in cities or rural villages across Europe, China, and New Zealand. In many cases, authors highlighted a surprising lack of scientific evidence about how DSI functions in practice and how the different actors learn from the experience so that the lessons learnt can promote reflection, rethinking, or even transformation of status quo at a time of significant change.

The article by Certomà (2020) presents and discusses the thematic issue's topic. It points out that space-related aspects have been incidentally addressed by innovation management and regional studies researches. In contrast, a critical geography approach could help refining the analysis of the urban space as a physical space augmented by digital connections. Interestingly, it could also reveal to what extent contemporary cities are merely working as laboratories for experimenting market-led technocratic solutions or as incubators of citizens' critical engagement. As such, critical geography helps unveiling how DSI initiatives are produced and mobilised in the society, along with discourses and imaginaries about technological development.

In turn, the studies by Dyer, Weng, Wu, Ferrari, and Dyer (2020), Leyshon and Rogers (2020), and Grossberndt et al. (2020) investigate how digital technologies can make it possible for citizens to expand their space of action in the city, by designing and realising much-needed autonomous initiatives.

In particular, the article by Dyer et al. (2020) describes how a new, in-house developed digital platform entitled 'Urban Narrative' uses computational linguistic tool FLAX to extract shared dialogue and stories from public engagement exercise initiated by the city of Christchurch, New Zealand, called 'Share and Idea,' following the 2010 and 2011 earthquakes. Using collocation methodology, the technique illustrated how the public's interests in key features about the city's soft and hard infrastructures could be readily identified and compiled to give an overall perspective about priorities for the future development of a city. The grassroots outputs from the public engagement exercises were compared with top-down governmental statistical data to either show agreement or disagreement on topical issues such as provisions of affordable public transport or security measures for street safety. Furthermore, the article drew intriguing parallels between processes involved in well organised public participation and the participatory design itself, both of which are needed for co-design or co-development of sustainable communities and cities.

In the case of Leyshon and Rogers (2020), a novel digital platform called CJNN aided online journalism to emerge in the community. The pilot study involved four local communities in Cornwall, UK. The intention was to produce a sense of place through sharing stories and images that reflect the lived realities of people's lives. The most relevant collaborative journalistic effort was a story cluster that produced mass collaboration about an unusual weather event that affected the entire geographic area of Cornwall. Ultimately, the research pointed out how digital technologies-aided socially innovative processes can support marginalised groups whose voices are often absent in the mass media.

The theme of grassroots engagement continues in the article by Grossberndt et al. (2020), who reported on results from a digital platform that enabled the public to record their perceptions of poor air quality in greater Oslo, Norway, and compare them with results from official measurements of pollution (PM10, PM2.5). This was undertaken using the digital platform cityAir and hackAIR. Although not intended to be directly correlated with measured values of air quality, the results show a reasonable agreement that confirmed expectations that air quality was poorest near road networks and especially in central Oslo. Quite rightly, the authors highlighted the opportunity these digital platforms provided to raise air quality awareness within the city and its surrounding suburbs. The results also raise questions about what you do with the results when it becomes very clear that the air quality in certain parts of cities is unacceptably poor.

In comparison with these grassroots initiatives, the results from two top-down institutional case studies—Devlin (2020) and Bolli's (2020)—discuss the political rationalities underlying the development and introduction of digitally-aided collaboration contexts.

The article by Devlin (2020) described early results from the introduction of a new urban planning and technology platform, #PlanTech, in the UK, funded by the central government 'Connected Places Catapult.' Specifically, the article reports on the results of an ethnographic study of planning functions for Coventry City Council. Most of the ethnographic study describes the challenge of selecting an appropriate software vendor in a highly competitive market. At this stage in the project, it was too difficult to draw firm conclusions about the success or otherwise of the initiative. However, it was interesting to note that one of the drivers for the project was political frustration at the perceived inability of existing planning processes to promptly deliver new urban developments to help stimulate the UK economy.

In comparison, Bolli (2020) focussed on the emergence of makerspaces in China as an example of the integration of top-down and bottom-up dynamics which were characterized as ephemeral spaces for innovators, hackers, makers, and entrepreneurs shaped by a cultural context. The first makerspaces reportedly opened in Shanghai and Shenzhen in 2010 and attracted the attention of the Chinese government, who in 2015 published an initiative that subsequently influenced the typology of makerspaces in China. As such, the Chinese government supported a more entrepreneur and business culture over self-development and tinkering. Makerspaces were seen as an opportunity to shift the image of China from a world manufacturer with the label 'made in China' to a nation of innovation with the motto 'designed and created in China.' As a result, the Chinese government's initiative reportedly reduced the number of makerspaces as it has transformed the idea of makerspaces into entrepreneurship. Even so, makerspaces are seen as having multiple, potentially dissonant, roles in the Chinese context, namely fulfilling the ideology of the urban China dream, participating in the growing sharing economy and platformisation of the Chinese society.

Middle-out collaboration patterns emerging from public institutions and citizens networking in DSI initiatives are explored in the last set of articles by Zerrer and Sept (2020) and Ersoy and van Bueren (2020).

Although the majority of articles discussed DSI in an urban setting, the article by Zerrer and Sept (2020) describes DSI in a rural setting in two villages in Germany and discusses the integration of top-down and bottom-up efforts. The case studies compared the emergence of DSI from a grassroots level in the village of Wokisrab compared to a top-down initiative in the village of Wesedun. The ethnographic study showed that in the case of Wokisrab, rural DSI was triggered by the arrival of a multi-use space with the only public Wi-Fi hotspot. The new activism led to a number of analogue social innovations before triggering engagement with regional competition that led to a new village strategy focusing on opportunities for digitalization, particularly on a digital communication platform and a shared village database. In comparison, Wesedun's journey towards rural DSI originated with participation in the Digital Countryside project co-funded by the European Union. The eventual DC project was managed by the Economic Development Corporation of the District. Wesedun realized five ideas were divided into two sections: demography, with the highest priority, and digital infrastructure. In order to meet the challenges of demographic change, the focus was to improve the quality of life, mobility, social integration, and autonomy of elderly villagers, for example through the village´s internet courses, regularly fully booked. In each case, the study characterized the development of rural DSI by so-called 'smart villagers' as either a bottom-up process with outside support in the case of Wokisrab or as a top-down bottom-up-interplay in the case of Wesedun. For both villages, different types of actors were involved in the process of DSI. On a vertical level, top-down actors typically comprised professionals from outside of the village, where as bottom-up actors involved volunteers, belonging to the village. On the whole, the study identified three main groups of actors to create DSI: drivers, supporters, and users.

The role of actors for DSI was also seen as an important theme in the article written by Ersoy and van Bueren (2020), which reported on the creation of three 'temporary' urban living labs (ULL) following the global financial crash of 2008. Located in post-industrial shipping yards on the outskirts of Amsterdam, the alternative schemes based at Buiksloterham (De Ceuvel, Schoonschip, New Energy Docks) were intended to be temporary (10 years). However, during the trial process, the local communities became concerned that traditional developments would be resumed once the crisis passed. Hence, in April 2015, a Manifesto Circular Buiksloterham was signed by 20 professional private and public stakeholders for the so called 'City Lab Buiksloterham.' The article investigates how different actors learnt from the ULL experience in terms of learning theories where single, double, and triple loop learnings processes led to increasingly deeper and transformational learning experiences. Yet, in practice, the replication of innovation was found to be problematic because learning theories are more concerned with the learning setting, whereas in ULLs actors learn within a particular context. Interestingly, knowledge institutes, consultants, and the local water company were found to play a key role disseminating lessons learnt to other places within Amsterdam and beyond. Likewise, the establishment of Manifesto/Living Lab Circular Buiksloterham provided the framework for City Lab to exchange experiences with similar 'bottom-up' initiatives in other cities.

In summary, the thematic issue provides a further contribution to the body of literature. It explores the different socio-political perspectives, participating actors, and governance processes activated by a broad range of existing DSI initiatives for appreciating the implications of the emerging socio-technological transformation in cities and regions.

Conflict of Interests

The authors declare no conflict of interests.

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Article

Digital Social Innovation and Urban Space: A Critical Geography Agenda

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Abstract
Digital Social Innovation (DSI) is a new concept referring to social innovation initiatives that leverage digital technologies potentiality to co-create solutions to a wide range of social needs. These initiatives generally take place in urban contexts. However, in the existing literature, scarce attention is devoted to the spatial dimensions and the social, cultural or political space-related effects of DSI practices. This article suggests that a critical geography perspective can address these gaps. After a review of existing relevant contributes, the article elaborates a research agenda for a critical geography of DSI. This articulates along four research lines, including the emergence of DSI networks, the (re)production of DSI processes and socio-cultural urban space, the representations of DSI practices and the power relationships these mobilise.

Keywords
critical geography; critical Internet studies; digital social innovation; urban space and spatialities

Issue
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1. In Search of the Spatial Dimensions of Digital Social Innovation

The concept of Digital Social Innovation (DSI) emerged in the last 10 years (Caulier-Grice, Davies, Patrick, & Norman, 2012; Henning & Hess, 2010) and refers to a:

> Type of social and collaborative innovation in which innovators, users and communities collaborate in 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. (Bria, 2014, p. 9)

As for other innovation experiences, also for DSI, the application context plays a significant role, for instance, in triggering or hampering profitable relationships. The city seems to offer the necessary conditions for experimenting with social innovation and its digital variant, by virtue of its relative spatial compactness, infrastructural and social density, high level of digital connectivity, and cultural diversification that is often accompanied by a propensity to test proposed innovations (Section 2.2). Nevertheless, the multiple spatial dimensions involved in, and implied by DSI processes have been significantly disregarded in the scientific literature, apart from some considerations on the relationship between space and DSI have been advanced in innovation management and regional economic studies (Section 2.2). However, the positivist understanding of space these last provide conflicts with a contextual and relativist appreciation of it.

This article claims that in order to get a more nuanced appreciation of DSI relationship with the fluid, mutable, multiple spaces of contemporary city (Harvey, 2006; Massey, Allen, & Sarre, 1999) we need to adopt a critical geography perspective (see Section 3).

Nevertheless, at present DSI does not appear amongst critical geography's research interests. To draw potential future research lines, the present article reviewed cognate works on the connections between geography and the digital turn, and the spatial implications of the smart city paradigm (Section 3).

Suggestions from Critical Urban Theory (Brenner, 2009; Marcuse, Imbroscio, Parker, & Davier, 2014), Science and Technology Studies and Critical Internet Studies (Hunsinger, 2019) have been complementarily considered. Building upon the above-mentioned research, a future agenda is eventually drawn along four lines, including: 1) the socio-spatial structures produced by and generating on its turn DSI initiatives (networks); 2) the DSI contribution in perpetuating society and technology relationships in the city ([re]production); 3) the space of imaginaries, narratives and visions created by DSI communities (representation); and 4) the entwining of socio-political issues brought about by DSI practices (power; Section 4).

2. DSI and Urban Space

2.1. DSI

In the early 2000s, the digital turn (Westera, 2012) determined a proliferation of web-based processes that granted existing social innovation initiatives (Moulaert, MacCallum, Mehmood, & Hamdouch, 2013; Moulaert, Martinelli, Swyngedouw, & Gonzalez, 2005) with the possibility to increase their efficiency, diffusion and effectiveness (Millard & Carpenter, 2014; Tepsie, 2014). Social innovation processes have been interpreted since the mid-19th century (Busacca, 2013) as organisational processes tending toward a more egalitarian society (Léveques, 2001). These processes are labelled as 'social' both in reference to means (i.e., performed through the participation of different actors; Sharra & Nyssens, 2019) and to ends (i.e., addressing situations which have negative impacts on people's lives and well-being). Their novelty is given by being new to the users, to the context of the application or about the adopted methods (Mulgan, 2006).

In the last 20 years, such an heterogeneous category of initiatives led by civil society tackled issues that States failed to address, and the market had no interest to address; and so re-attracted social scholars' attention (Cajaiba-Santana, 2014; Moulaert et al., 2013; Westley & McGowan, 2017). The reusing of abandoned buildings (e.g., Refill project), the organisation of new commons (e.g., CommonsTransition, 2020), the realisation of community gardens (Bell et al., 2016), the creation of sharing economy or community currency systems (e.g., Torekes, 2020) can be all considered as forms of social innovation.

Today, digital tools are widely recognised as crucial enablers of social innovation (Maglavera, Niavis, Moutsinas, Passani, & de Rosa, 2019). However, they do not only trigger, empower, mediate or even transform existing social innovation processes; but also (promise to) innovate the forms and functioning of society whose constitution is deeply pervaded by digital technologies. Therefore, the category of DSI emerged as a novel and distinctive field of practice, compared to the social innovation one (Maglavera et al., 2019; Ozman & Gossart, 2019; Rodrigo, Palacios, & Ortiz-Marcos, 2019). It can be defined as an "organisational network model leveraged by information and communication systems" (Rodrigo et al., 2019, p. 64), which relies on "the capacity of civic society to formulate a problem, bring it to the fore of public arenas, and engage a variety of stakeholders to jointly frame and solve this problem" (Ozman & Gossart, 2019).

The definition of DSI has been elaborated by European digital activists and policy researchers, often (but not exclusively) supported by the European Commission's (henceforth EC) funds (Anania & Passani, 2014). Up to 2014, DSI initiatives principally gathered under the EC *Collective Awareness Platforms for Sustainability and Social Innovation: CAPS* (EC, 2020a) umbrella, complementing the market-oriented *Digital Agenda for Europe* (EC, 2020b) strategy. More recently, in the context of global geopolitical manoeuvres for the leadership of the digital market (Zuboff, 2019), and in consideration of citizens' concerns for ethical implications of ICTs diffusion in private and public life, further than under the pressures of digital activists, the EC decisively characterised its digital development strategy by devoting attention to social concerns. This brought, for instance, to the definition of an ICT-enabled social innovation perspective aimed at boosting communitarian welfare system (Maglavera et al., 2019) and to the funding of the Next Generation Internet (2020) program, which can be regarded as an attempt to advance a distinctive European position in the global panorama dominated by the US vs. China struggle for the dominance of the digital technology market (Internet Governance Project, 2020).

It is against this backdrop that most of the available research on DSI have been produced in the form of grey literature (i.e., reports, position papers, proceedings and policy plans) by EC specialised agencies, department, consultants and project teams (EC, 2020c). EU-funded projects (see the Supplementary File) often propose the pilot applications of new public services and products in local contexts. These include, for instance, the opening of local labs for sharing, repairing or building new devices (e.g., EU projects TESS, EDFx, SISCODE; see the Supplementary File); the life quality enhancement for helping non-autonomous people of single-parents or for assisting patients (e.g., EU projects OPENCARE, WE4AHA, PRONIA); the improvement of environment care, e.g., by lowering individual and groups' carbon emissions (e.g., EU projects CAPTOR, SHELTER, HYPERION); or the boosting of place-based innovations via consultancy and infrastructures provision (e.g., EU projects SI-DRIVE, SIMPACT).

The panorama of DSI initiatives in Europe, however, expands beyond the EC-funded projects (often significantly biased by the willingness to encountering evaluators' consensus; Engelbert et al., 2019). City councils, NGO or CSI organisations, social entrepreneurs (e.g., fablabber, start-upper, social hackers, etc.) independently promoted and self-financed DSI initiatives, covering a wide range of issues (Table 1).

Table 1. Examples of non-EU-funded DSI projects.

Issue area	Name of the project
Improvement of civil government and planning processes	Better Reyjkavik (Iceland), Decide Madrid (Spain), Liquid Democracy (Germany), Writetothem (UK), Fragdenstaat (Germany)
Community cohesion and solidarity links	Buonacausa (Italy), Spacehive (UK), Freegle (UK), No Lo Tiro (Spain), Graines de Troc (France)
Proximity services provision	Peerby (Belgium), Artportalen (Sweden), Nappy Napuri (Finland)
Citizens participation in political life	Open Ministry (Finland), Citizen Foundation (UK)
Production and working models	Commons Network (Germany), Edgeryders (Estonia), Future Everything (UK), ThingsCon (Global), Waag (The Netherlands)
Technological accessibility	Arduino (Italy), WeProductise (Portugal), CommonFare (Italy)
Personal, social and environmental care	Freecycle (Global), The Impact Lab (Luxembourg)

The panorama of DSI initiatives is very dynamic and volatile, however indicative figures signalled that in 2019 the movement of digital social innovators in Europe counts over 2,240 collaboration projects brought forth by about 1,500 organisations (Stokes, Baeck, & Baker, 2020). These projects combine ideal aspirations with the development of not-for-profit solutions, elaborated through a co-design and co-production approach that distinguishes DSI from digital innovation per se. On this regard, DSI presents affinities with grassroots innovations as it creates opportunities for civic engagement and empowerment (Moulaert et al., 2005). Still, it distinctively does so by bringing together civil society through the use of digital platforms (Ozman & Gossart, 2019). Therefore, an encompassing formula describes DSI initiatives as "a wide range of projects that use digital technologies, community engagement and collaboration, co-creation strategies and bottom-up approaches to solving societal needs, in opposition to the centralised proprietary solutions owned by a few companies" (Cangiano & Romano, 2017, p. 3546).

2.2. Urban Space and Place-Baseness

The recent popularity of decentralised solutions to social challenges (Hall & Pfeiffer, 2013; Heynen, 2014) also explains why urban contexts are assumed as the "hotbeds for innovative policy-making and strategies" (Barcelona Activa, 2018). From an institutional perspective, the EC identifies key traits that make the city attractive for testing social innovation, including the diffused small entrepreneurialism, the job-market creativity and the presence of a rich substrate of local skills and culture (JRC, 2020). Not surprisingly, the contemporary city represents the most frequently adopted contexts for the realisation of DSI project (Brandsen, Cattacin, Evers, & Zimmer, 2016; INEA, 2020; Vandecasteele, Baranzelli, Siragusa, & Aurambout, 2019) because "when…combined with digital technologies, our urban habitat becomes the most sophisticated technology for interaction ever created" (Han & Hawken, 2018, p. 2).

However, limited attention has been devoted to the different spatial dimensions (such as the physical, technological, semantic, symbolic and socio-cultural ones) DSI mobilises in the urban assemblages. This lack is likely due to the disciplinary perspective, i.e., the innovation management and regional development approaches (Dacin, Dacin, & Matear, 2010; Dawson & Daniel, 2010; Moulaert et al., 2005), that largely dominated research on DSI and the EC policy-making (Rissola, Hervas, Slavcheva, & Jonkers, 2017) up to now. Specifically, place-baseness stands out as the prominent spatial dimension investigated in management-oriented literature with regard to DSI. It refers to the context-dependent conditions (Eckhardt, Kaletka, & Pelka, 2018) that are supposed to help the inventive and operational capability of digital social innovators (Boelman & Heales, 2015; Millard & Carpenter, 2014, p. 15). This flourishing research stream provides examples of cities considered as perfect ecosystems where the harmonic orchestration of ideas, institutions, regulations and policies feeds the EU smart-specialisation strategy (EU Science Hub, 2020; Whittle, Ochu, & & Ferrario, 2012). For instance, the collaboration between the municipality and the Technology Park in Ljubljana that allowed the emergence of start-ups, co-working spaces, geek houses and hackathons is proposed as a good practice (Bučar & Rissola, 2018). The impact of such innovation on local development are generally assessed on the base of managerial or economic effects connected with institutional or organisational changes in local institutions' routines and the work culture (Alvord, Brown, & Letts, 2004; Kaletka & Pelka,

2015; Mulgan, 2006; Seyfang & Smith, 2007; Van der Have & Rubalcaba, 2016), with no further discussion of the spatial implications.

Analytic research on influential factors that fuel the emergence of DSI has been performed in two EU-funded projects, i.e., DSI4EU and SI-DRIVE. Together with more expectable elements (e.g., dedicated policy measures, resources availability, active citizenry, attractiveness for the creative class, presence of high-level research and education institutions), these suggest that distinctive assets include the presence of 'intractable social problems' that both the public and the market failed to address (Murray, Caulier-Grice, & Mulgan, 2010); and "the presence of an active civil society endowed with a sufficient level of technological literacy and technology access potential" (SI-DRIVE, 2017). Nevertheless, the final *City Index Report* (DSI4EU) by Nesta UK concluded that it is:

> Simplistic to think [that] the eco-systemic factors and activity should correlate closely….Many DSI initiatives emerge as a response to unfavourable social, political and economic contexts, in an attempt to address social issues that have been overlooked by traditional institutions. Some of the cities which are high-ranking in the index might simply have less need for DSI; and some of the cities which are low-ranking in the index might have conditions which lead people to develop DSI against the odds. (Stokes, 2020)

This leaves, once again, open the issue of the relationship between DSI and urban space, particularly in its socio-cultural aspects and suggests the need for a critical geography reflection on DSI.

3. With the Help of Critical Geography

The multiple urban spatial dimensions and the spatialities implied, generated or transformed by DSI initiatives have not been adequately considered up to now because the mainstream approach to innovation hampered the possibility for a critical geography appreciation. Critical geography, as a variant of the rich tradition of critical social thinking, is not a coherent epistemology but rather an orientation in geographical research (Murdoch, 2005; Soja, 1989) that embraces political stances to unveil inequalities, injustices and dominations perpetuated through mentalities creation or material forms of coercion (Blomley, 2006); and advances progressist and liberatory claims via the scientific practice.

A critical geography approach to DSI can, thus, foster the exploration of the micro-physical conditions and structures where projects are realised (e.g., a lab, a garage, a square); their social and physical closeness or distance from contexts where similar experiences are performed and from involved communities; the relational proximity to the where tackled problems manifest or from where competences to solve them are made available; the social geography it embeds within; the space of agency conceptualised by involved actors and the symbolic meanings they circulate through the process; the flow of economic resources, competences, and the power that fuel DSI processes; and their impact in terms of people's recognition, empowerment, accessibility and inclusion.

Building upon critical geography tradition (Massey, Allen, & Sarre, 1999; Merriman et al., 2012), the following pages propose some research streams thought which a future research agenda on DSI space and spatialities (i.e., the relative and relational idea of space produced by social interactions; Amin, 2002; Merriman et al, 2012; Lefebvre, 1974/1991; Sheppard, 2002) can be articulated.

While not explicitly addressing DSI, critical geography contributions on related issues, i.e., the digital turn and the smart city, provide useful feed for thoughts. These signalled that both the concept and the experience of space underwent profound changes in the digital age (Ash, Kitchin, & Leszczynski, 2018; Cairncross, 1997; Castells, 1996; Friedman, 2005; Harvey, 1989). The digital turn has determined, in fact, an expansion of the urban space by upgrading its material dimensions up to merging with the virtual ones, in single reality—a sort of digital 'hypercity' (Landi, 2019; Massey & Snyder, 2015). The virtual space of a city can be regarded, thus, just as a continuation of the city around, inside, beyond and behind its physical space, as an 'augmented urban space' (de Cindio & Aurigi, 2008).

Notably, the diffusion of digital technologies in social life produced dramatic shifts in the production and conception of space, and so it did on spatiality because it produces new spatial relations on multiple layers that can be defined as 'digital spatialities' (Gairola & Roth, 2019). Digital spatialities are, thus, the effect of the social encounter with space mediated by the digital tools and processes (which increasingly constitute our daily experience of space and its mode of production; Ash, 2009; Sutko & de Souza e Silva, 2010). These new spatialities have been differently named as code/spaces, hybrid spaces (de Souza e Silva, 2006), digiplace (Zook & Graham, 2007), net locality (Gordon & de Souza e Silva, 2011), augmented reality (Graham & Zook, 2013), mediated spatiality (Leszczynski, 2015), to mention but a few. The diffusion of digital technologies, the interactive web and the Internet of Things has modified the urban hardware and software, i.e., the physical structure and the functional organisation of the digital city (Dyer, Gleeson, & Grey, 2017). Komninos, Pallot, and Schaffers (2013) identified four main phases of the digital city production. In the first phase, certain activities—reinforcing and amplifying traditional city functions—have been transferred to the web environment and opened to non-experts via the creation of static web pages that provided information about the urban area with text, maps and pictures (Couclelis, 2004, p. 5). The emerge of the interactive web (i.e., the Web 2.0) characterised the second phase. City relationships with the digital have been made

possible by the diffusion of the ADSL communication bandwidth, the development of Open Source Content Management Systems and the web publishing PHP language (Komninos et al., 2013). As a concequence, the virtual space of the city has been rapidly crowded with collaborative platforms, wikis, blogs, social networking sites, media sharing, hosting of web applications, mashups and similar (Barkat, Jaeggli, & Dorsaz, 2011). At the end of the 2010s, the third phase has been characterised by the emergence of embedded systems and wireless networks. These made the city metabolism measurable by elaborating data from sensors and interconnected smart devices. Retrieved big data have been made available to citizens via augmented reality applications (Tselentis et al., 2010). Today, the digital city (Mossberger, Tolbert, & Franko, 2013) relies on "the open data urban system [that] demands open innovation models and people-driven innovation models to turn capabilities offered by data and technologies to services and solutions" (Komninos et al., 2013, p. 24). The routinely adoption of digital technologies for addressing social problems constitutes a normalisation of previous eccentric practices; and supports the emergence of digital governmentality (Burchell, Gordon, & Miller, 1991; Dean, 1999; Rajagopal, 2014), whose predictive analytics are used as a new technology for measuring population dynamics; and whose constant incitation to action works as a strategy for impulses and desires control (Barry, 2019).

The digital governmentality, which characterises the technocratic governing of the smart city, has been fiercely criticised by critical geographers (Cardullo, di Feliciantonio, & Kitchin, 2019; March & Ribera-Fumaz, 2014; Vanolo, 2013). Together with critical urbanists (Marcuse et al., 2014), these last investigated "how current capitalist organisation shapes processes of sociopolitical, economic and environmental inequalities and deconstruct the discourses underpinning these" (Verrest & Pfeffer, 2019). In fact, despite the digital revolution was intended to subvert the 19th centuries elites and to redistribute power (Cadwalladr, 2013; Turner, 2006), after a few decades, it produced a power concentration in the hands of a few big companies (notably Google, Facebook, Amazon, Microsoft, Apple), which are able to acquiring patents, engaging hackers and investing in all of the promising Internet of Things and Artificial Intelligence initiatives. Therefore, the digital turn produced its élite and a fracture between those that are in the position to control and modify the codes governing our social (and private) life operations, those who passively use them, and those who have no access at all to the technological devices and the digital infrastructures. The resulting digital divide (van Dijk & Hacker, 2003) is not limited to the access to technological infrastructures and devices but is also generated by social and cultural barriers (including digital literacy, education, linguistic competences, individual and rights protection; Norris, 2003; Selwyn, 2004; Warschauer, 2004). These conditions produce new geometries of power with their own organisational logics (de Wall, 2015), which can be easily detected in the urban arena. Here the push toward public participation, transparency and openness have been embedded in the smart city programmes and often co-opted by private tech-companies, or by government organisations whose digitalisation plans are heavily conditioned by business companies' investments. An increasing number of critical voices raised to unveil how the corporate storytelling of the hyperconnected city (Söderström, Paasche, & Klauser, 2014) infiltrates urban planning; and revealed the practical difficulty of negotiating between contrasting public and private interests (Gladwell, 2013; Morozov, 2012; Turkle, 2011).

Although critical geography literature on smart city provides exciting insights, nevertheless this does not specifically refer to DSI. While related, in fact, a smart city does not necessarily host DSI processes, nor the performance of DSI processes is limited to smart city contexts.

4. A Critical Geography Agenda

Existing reflections on digital geography and the smart city suggest that critical geography research can provide equally exciting insights when applied to DSI. To this end, multiple geography traditions can be mobilised. Notably, the perspective of Actor-Network-Theory (Latour, 2005; Law, 1995), a transdisciplinary field rooting in Science and Technology Studies, provides a useful standpoint to analyse the social construction and reception of technologies (Bijker, Hughes, & Pinch, 2012; Hinchliffe, 2008; Whatmore, 2002). Even though it attracted critiques for not embracing the post-structuralist analysis of power relationships (Hetherington & Lee, 2000; Whittle & Spicer, 2008), it is an effective explanatory tool in considering how spaces materialise through networked agency (Murdoch, 2005). Radical geography tradition, on the other hand, rooting in the Marxist tradition (Bakker & Gill, 2003; Katz, 2001; Peet, 1977), offers a standpoint for analysing the societal (re)production practices, particularly in terms of inequalities and the generation of dominant social structures (Hubbard, Kitchin, Bartley, & Fuller, 2002). Research on socio-spatial representations can be performed by adopting a post-modern critical geography approach (Castree, 2000; Peet, 2000). Representations include narratives, visions and discourses that attribute meaning and values to collective imaginaries; and make thinkable ideas, practices and events untaught (or unthinkable) before. This research stream revolves around the issue of symbolic and material power and its spatial configurations (Crampton & Elden, 2007). Contributes from Critical Digital Studies (de Rosnay, 2006; Kroker & Kroker, 2013; Lanier, 2006) can prove equally useful. These include inquires on how digital technologies influence the practice of society and space production, alongside its contestation and transformation against the backdrop of digital geopolitics.

Following the polyvocal vocation of critical geography (Blomley, 2006) research lines proposed below do

not add up to one framework, but pinpoint aspects along which the space and spatiality of DSI need to be examined in more depth. These research lines aggregate into the following four clusters.

4.1. Networks, or How Spatial Infrastructures Bring DSI into Existence

Every DSI initiative can be understood as the emergent effect of a network of networks in which semiotic and material aspects merge. Understanding how these networks interact and create new spaces of social action is crucial to disarticulate the socio-spatial logic of DSI processes (Millard & Carpenter, 2014). The emergence of a new DSI process is produced by the gathering of a social collective (or 'assemblage') that provide the core innovative technology (i.e., the 'artefact'; MacKenzie & Wajcman, 1999). In working, testing, improving the artefact (being it a tool—such as an application, a platform or a sensor; or a process—such as a participatory budget or a crowdsourcing algorithm) the collective continuously reframes the problems it is intended to solve into higher-order learning. Each actor of DSI keeps connections and brings along other networks it is already involved in, and therefore makes the boundaries of the system extremely porous and fuzzy. Moreover, a collective's agency generates further networks of higher scale order. These may emerge, for instance, from the relationships amongst similar DSI initiatives (e.g., all the collaborative urbanism digital platforms initiatives); or initiatives financed by the same founder or promoted by the same promoter (e.g., all the DSI initiative funded by the EC); or cognate initiatives happening in the same city or region, aiming the same goal or even adopting a similar set of technologies. How involved actors locate in the physical and social space, and how their interaction connects different sites of knowledge, decision and material production along the DSI processes is still open to investigation.

4.2. Re-Production, or the Material Production of DSI and the City

While a prolific research line in critical geography attempted at charting the digital space (Dodge & Kitchin, 2008), the (bio-)politics of algorithms (Graham, Zook, & Boulton, 2013; Thrift & French, 2002), and the critical smart cities (Greenfield, 2017; Kitchin, 2014; Verrest & Pfeffer, 2019), the (re)production processes of the augmented city remained almost unexplored. DSI initiatives, emerging at the crossroad between the rapid evolution of digital innovations and the cogency of social challenges, clearly show how the transformations of the coded set of procedures that make a city working (i.e., the urban software) can be impacted by different actors. This calls for the consideration of how the social production of space (Lefebvre, 1974/1991) is mediated through the social construction of technologies (Glimell, 2001), via reproductive processes of the places where DSI processes happen, and "the contentious economic, social, political, and historical contexts of their geographies" (Ash et al., 2018; see also Graham, 2011). A promising research line, therefore, could investigate how DSI processes work as social technologies (Foucault, 1977, 1980), through the combination of power (i.e., the practices, mechanisms, technologies, etc. that constitute authority) and knowledge (i.e., the forms of thought and expertise used to frame and inform the process of governing).

4.3. Representations, or the Symbolic Production of DSI and the City Space

Most of the innovative capacity of DSI communities is primarily exerted in the creation of new visions and narratives, because "rather than [practically] invent a new type of city, the extraordinary array of smart technologies available allow existing spaces to be reconfigured, experienced and imagined in new ways" (Han & Hawken, 2018, p. 2). DSI processes are enacted through ad-hoc narratives (e.g., the collective intelligence or enabling-technology; Turner, 2006), imaginaries (e.g., the Next Generation Internet, or the punk-Internet activism; for the latter see Harris, 2018), and visions (e.g., the smart city, the people friendly city, the resilient city, etc.). The strength of DSI representations roots in two assumptions that made the digital turn possible. Firstly, the positive connotation of direct participation practices in a democratic society, associated with ideals of accessibility, transparency and engagement; second, the 'wisdom of the crowd' (Surowiecki, 2004) mantra, that, apart from some contestations (Lanier, 2006), has had a profound impact in shaping our collective vision of a collaborative society of expert citizens operating through decentralised and connected platforms. Moreover, different social imaginaries hold a connection with various technological tools and contribute to the constitution of urban contexts supporting or impeding progressive changes in society and space. It is through these representations, vehiculated by digital technologies (e.g., web sites, platforms, social networks, federated interned platforms) or even participated via web-based processes (e.g., storytelling and mapping of DSI initiatives) that peoples create spatial attachments. All of these topics represent a vast, only partially explored research domain.

4.4. Power, or the Entwining of Socio-Political Issues Brought about by DSI Practices

DSI initiatives are very diverse and roots in opposite worldviews and ideals, directly connected with the political value of adopted technologies (Ash et al., 2018; Sampler, 2019). The described mainstream perspective of management-oriented studies (Section 2) regards DSI as functional to reconfiguring market structures and governance patterns that create services for unanswered so-

cial demands. According to this approach, both technical and organisational innovations are pursued to facilitate the automation of tasks and to improve the quality and efficiency of business or government processes (Misuraca, Pasi, & Urzi Brancati, 2017). For instance, the European approach to DSI and the US perspective on the cognate phenomenon of CivicTech, adopt a functionalist perspective but present a different understanding of the role of public and private actors in the governance of urban life. While the first assumes that the economic profit of DSI entrepreneurs is only intended as a side effect of the resolution of a social problem (Nicholls, Simon, & Gabriel, 2015); the second promotes digital governance processes supported by the private investments of big ICT companies (such as IBM or Microsoft; see Civic Graph Atlas, 2020). Despite the differences, however, both of them align with the neoliberal paradigm of market-led innovation pursued by digital capitalism (Bendiek, Godehardt, & Shulze, 2019; Internet Governance Project, 2020).

A radically different approach characterises DSI initiatives of digital activists endowed with the intention to radically subvert the existing structure of digitally mediated governance (e.g., Indie.ie or Mastodon project). Such a revolutionary understanding is regarded by many as interpreting the very nature of DSI, whose aim is to change the socio-technological cognitive frames of reference and alter the current social systems, by working outside of the institutional settings (Misuraca et al., 2017). Walking on the edge between reworking or subverting existing institutions, many European DSI communities presented their core values in a short *Manifesto for Digital Social Innovation* (ChiC, 2020). These include the quest for adoption of open and transparent operational modes that prevent citizens' online activity from being locked into proprietary systems; for decentralised Internet system that promotes citizens' sovereignty over their digital life; and for a sustainable approach to proposed innovation via re-designing Internet governance rules. The *Manifesto for Digital Social Innovation* (ChiC, 2020) is resonant with the Internet activists' proposal of *a Shared Digital Europe* (Blomen, 2020) and the *Universal Declaration of Cyborg Rights* (see Ind.ie, 2020). These embrace democratic values and strives for equity and social justice via enabling processes of self-determination on private data, cultivation of the (digital) commons, decentralisation of infrastructure and empowerment of public institutions.

Distinguishing between different forms of DSI, while rarely acknowledged, is essential for appreciating how these processes play very diverse roles in the reproduction of (digital) capitalism and the discursive, political and material transformation of urban space.

5. Prospectives on Space and Spatiality of DSI

The article builds on the assumption that DSI is a multifaced phenomenon that has not been sufficiently investigated from a critical perspective up to now. Space-related aspects have been incidentally addressed by innovation management and regional studies research, but critical geography can help at drawing a more refined future research agenda. To this end, the article briefly reviewed of geographical research on related issues, i.e., the digital turn and the smart city, and—building upon them—elaborated four potential research lines to examine the DSI phenomenon. The suggested agenda starts with the proposal to investigate the DSI processes as networks of networks, whose functioning make apparent the true nature of the urban space augmented by digital connections. The operational networks generate multiple spatialities that call for the analysis of how the city hardware and software are produced and reproduced via digital and social technologies. In this context, research on representations is crucial because it can deconstruct the mainstream positive narrative of the smart hyperconnected city, functional to the (re)production of the digital capitalism. It can reveal whether cities are to be regarded as mere laboratories for experimenting market-led technocratic governance solutions, or as incubators of citizens' critical engagement, which can also detect and defuse the unwanted consequences of the DSI.

A critical reading of the hegemonic logic of the digital turn (Agyemanm, 2015; Cardullo & Kitchin, 2018), driven by research into the imaginaries and practices of DSI communities, can eventually emerge. Such a critical reading is intended to reveal how DSI processes are produced and circulate in the society, and how they enhance and maintain specific spatial configurations; and under what conditions they work as progressive and emancipatory political gestures. Along this research line, it is possible to investigate how DSI initiatives fuel the transition from a business-led, techno-deterministic city to a socially innovative community-driven one; and how they create technological tools and processes on the base of people's needs—rather than corporates' interests (Calzada & Cobo, 2015). Therefore, the supposedly progressive, democratic and empowering character of DSI can be problematised at the light of the techno-material practices adopted, their accessibility and effectiveness, their socio-political impacts (e.g., empowerment possibility, room for participation, data and infrastructures ownership and control). Moreover, it can unveil how technological practices associated with DSI initiatives chart discourses, infiltrate material methods in a relational, contingent and contextual way, and how they sustain particular kinds of interests in the society, by also feeding existing geometries of power or creating new ones.

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Conflict of Interests

The author declares no conflict of interests.

Supplementary Material

Supplementary material for this article is available online in the format provided by the author (unedited).

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Article

Urban Narrative: Computational Linguistic Interpretation of Large Format Public Participation for Urban Infrastructure

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Abstract
Urban Narrative works at the interface between public participation and participatory design to support collaboration processes for urban planning and design. It applies computational linguistics to interpret large format public consultation by identifying shared interests and desired qualities for urban infrastructure services and utilities. As a proof of concept, data was used from the Christchurch public engagement initiative called 'Share an Idea,' where public thoughts, ideas, and opinions were expressed about the future redevelopment of Christchurch after the 2011 earthquakes. The data set was analysed to identify shared interests and desired connections between institutional, communal, or personal infrastructures with the physical urban infrastructures in terms of buildings, public places, and utilities. The data has been visualised using chord charts from the D3 JavaScript open source library to illustrate the existence of connections between soft and hard urban infrastructures along with individual contributions or stories. Lastly, the analysis was used to create an infographic design brief that compares and contrasts qualitative information from public consultation with quantitative municipal statistical data on well-being.

Keywords
city; computational linguistics; infrastructure; narratives; public participation; urban narrative

Issue
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1. Introduction

As recognised by the UN SDG 11, cities are more than hard infrastructures of utilities, buildings and public spaces (United Nations, 2018a). Cities are communities of individuals and families with different backgrounds, needs and aspirations (United Nations, 2018a, 2018b). For cities to work well, they need to reflect the underlying value system(s) of these communities together with more formal institutions and the corresponding qualities required of soft and hard infrastructures as described by Dyer, Gleeson, and Grey (2017). This requires urban practitioners to listen to both *what* people need and critically understand *why* based on underlying value systems. In the past, it has been difficult to capture this information at a large scale simply due to the practicality of liaising with large groups without losing contextual information about people's needs and aspirations (Certomà, Dyer, Pocatilu, & Rizzi, 2017; Dyer, Corsini, & Certomà, 2017).

With this in mind, Urban Narrative was funded by the New Zealand National Science Challenge for Better Built Homes Towns and Cities to adapt and develop digital tools to process large text-based data sets from public engagement exercises. Working in partnership with the Christchurch City Council, this article outlines the development of such tools to facilitate evidence-

based decision-making at multiple scales by processing data from the post-earthquake 'Share an Idea' public consultation. Using syntactic text analysis software, text data from 300 stories taken from the Christchurch City Council's *Common Themes from Public Ideas* report (Christchurch City Council, 2011) were processed in relation to soft and hard infrastructures to reveal citizen interests and expectations for urban infrastructure. In this instances, the term 'soft' refers to public administrative, organizational, and social structures present in a city, whereas the term 'hard' describes the physical components of a city that enable the soft infrastructure to function (Campbell, 2011; Casey, 2005; Landry, 2012; Newman & Jennings, 2012; Tonkiss, 2014). The result is a visual data story of citizen contributions based on 'lived experience' of a place and expectations from urban infrastructure. The digital tools have been shown to have the capacity to share knowledge about urban systems at multiple spatial scales and enable a more collaborative approach to urban planning and design by bridging the gap between top-down and bottom-up planning process as illustrated in Figure 1.

2. Theoretical Foundations

2.1. Public Participation vis-a-vis Participatory Design

Urban Narrative works at the interface between public participation and participatory design. The former is concerned with enhancing public democracy processes by providing direct participation in government, whereas the latter occurs more in the private sector as a means of improving design processes for specific products, places, or services. At first sight, the processes might appear distinctly different; yet, in practice, there is a lot of common ground between these processes where each is concerned with who and how people participate along with their ability to influence decision-making. In that regard, the seminal works by Fung (2003, 2006) characterised public participation as having three distinct elements (or dimensions), namely: who are the participants, how the participants communicate, and what is the impact of the participation exercise. The approach is developed further as a three dimensional 'Democracy Cube.' In a similar manner, the later work by Nabatchi (2012) advocated a framework for designing public participation comprising eight elements (or propositions). The main characteristics of both frameworks for public participation can be summarised as follows:

- Deliberative modes of communication to identify and understand public values
- Collaborative process focussed on common interests (values) instead of fixed positions
- Shared decision-making to resolve values-based policy conflict
- Provision of information to better inform participants and aid good quality decision-making
- Recruitment strategies that are representative of diverse stakeholders and avoid bias

In comparison to public participation processes for public policy, participatory design is an overarching term for one of several different people centred design processes (Sanders & Stappers, 2008). A key feature of participatory design is the involvement of the 'user' as a design partner in the design process rather than being a subject to be observed or observer. As such, it places people at centre-stage within the design process and differs from user-centred design which focuses on use and usability (Ehn, 2008). Hence, participatory design is fashioned from two complementary values, the first being the right to participate in design activities and the second a means of bringing tacit or non-discursive knowledge of users into design thinking. In practice, it generates design activities and prototypes as part of the design process. The designer becomes a facilitator or what Ehn (2008) describes as a responsive designer, one who alternates the leadership roles in a project depending on whose skills are most relevant, including her own, while at the same time keeping

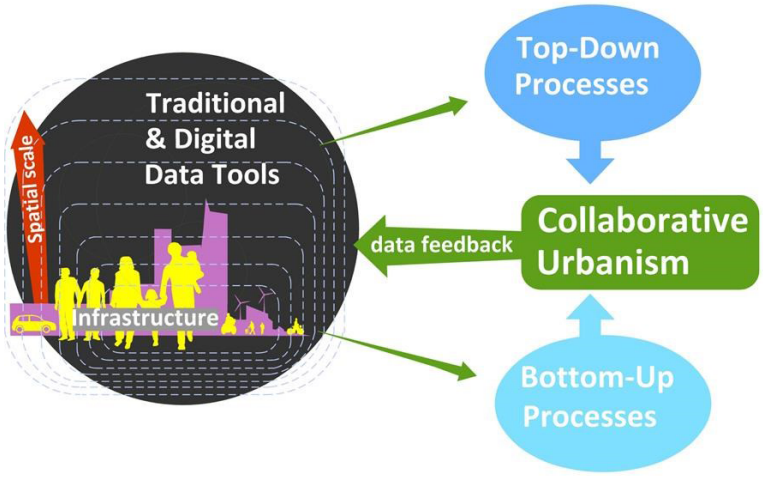

Figure 1. Big and small data informing top-down and bottom up processes. Source: Grey, Dyer, and Gleeson (2017).

all participants involved. Intriguingly, Dewey (1984), as one of the thought leaders for public participation in the early twentieth century, implicitly recognised the overlap between public participation mechanisms and participatory design by once remarking that "the man who wears the shoe, not the shoemaker, knows best where it pinches.''

As recognised by Fung (2003, 2006), Nabatchi (2012), and later Dyer, Gleeson, Ögmundadottir, Ballantyne, & Bolving (2017) plus Gleeson and Dyer (2017), one of the major challenges with participatory mechanisms is the creation of a deliberative process for a representative group of participants to critically define and solve a problem whether it be in the public policy arena or in the design of a new product. Traditionally, the scale of the deliberative process is a controlling factor. As observed by Nabatchi, a large format process typically takes place in townhall style meetings that tended to foster one-way communication, whereas a small table format process of 8–12 individuals fosters two-way communication but needs integration and up-scaling to be representative of a wider audience.

One relatively recent approach towards democratizing decision-making for public policy has been the emergence of participatory mapping using online Geographic Information Systems (GIS). Termed Public Participation Geographic Information System (PPGIS) from a meeting of the National Center for Geographic Information and Analysis in the US in 1996, the novel participatory mechanism was viewed as an opportunity to bridge the gap between the expert-driven technical world of land use planning and bottom-up lay knowledge from lived experiences. As critiqued by Brown and Kytta (2014), there are numerous case studies worldwide where PPGIS has been implemented to improve data collection by individuals or groups to inform and influence land planning and management decisions. Case studies typically involve recording positive or negative subjective spatial attributes connected to physical locations, such as fishing activity linked to a body of water. However, has noted by Brown and Kytta (2014, 2018), the idealised version of PPGIS has not substantially materialised. Instead numerous barriers have emerged to negate collaborative processes in the public administration. These barriers are attributed to a risk adverse culture, lack of incentives, short term budgets, planning horizons, etc.

Some of these barriers was observed by Dyer, Corsini, and Certomà (2017), where an extensive bibliometric analysis of 14,883 articles from ISI Web of Knowledge found a noticeable divide between published research into urban governance, urban planning, and urban design. The results were plotted using terms extracted from articles sourced using key phrases 'urban planning,' 'urban development,' 'urban design,' or 'urban governance,' where each publication had at least one key phrase in both the title and abstract of the manuscript. The term map indicated a significant divide between the traditional fields of social sciences, built environment disciplines, and information technologies. Typically, the reviewed published articles recorded research into urban governance that did not translate into design decision-making for land use or alternatively focused exclusively on urban planning and design with little attention to urban governance. There seemed to be negligible common understanding or framework to translate aspirations for greater citizen participation into improved planning, design, and construction of city infrastructures.

Exemplars do exist of public participation influencing public policy at the city scale. For example, the ethnographic study reported by Dyer and Ögmundardóttir (2018) documents the successful transition of two Scandinavian cities towards becoming fossil-fuel free conurbations. The success depended on each city populace identifying common but distinctly different narratives that resulted in significant new investment in renewable energy infrastructure, refurbishment of homes together with establishment of new education facilities for reskilling workers. In the case of Växjö the common narrative was one of protecting and valuing the environment through making good use of local resources in particular from forestry. Whereas the theme for Sønderborg was one of job creation and business opportunities brought about by the creation of Project Zero as a formal partnership between private and public sector organisations. In both cases, the transition teams benefited from the involvement of enthusiastic champions from either grassroots activists (Växjö) or business leaders (Sønderborg) who facilitated dynamic two-way communication and networking that was backed by political consensus. The outstanding success led the researchers to speculate if computational linguistics could be used to support similar large-format public participation mechanisms by identifying common narratives centred around share interests.

2.2. Computational Linguistics

As a first step towards analysing meta data sets from public consultation, Urban Narrative employed syntactic analysis and in particular collocation of key words to identify references to key features or attributes of urban infrastructure (e.g., green space, safe streets, affordable public transport) of importance to individuals or groups.

Syntactic analysis is a component of computational linguistics that employs computer science techniques to analysis and synthesis language and speech that includes the syntax and semantics of a sentence. Syntax itself is concerned with the structure of sentences in a language (e.g., nouns, verbs, adjectives, etc.), whereas semantics is the study of meaning in language.

As noted by Wu (2010), the term 'collocation' has many definitions in the literature. Nattinger and DeCarrico (1992) define collocation as "a string of specific lexical items that co-occur with a mutual expectancy greater than chance." Nation (2001) identifies collocations as "items which frequently occur together and

have some degree of semantic unpredictability." Benson, Benson, and Ilson (1986) call them "fixed, identifiable, non-idiomatic phrases and constructions." In the view of Lewis (1997), "collocations are those combinations of words which occur naturally with greater than random frequency." Sinclair (2004) describes the phenomenon of collocation as "the choice of one word conditions the choice of the next, and of the next again." In statistical terms, a collocation is two or more consecutive words with a special behavior (Manning & Schütze, 1999). In practice, extracting collocations from a corpus of text generally involves five steps:

- extract a set of candidate collocations from the corpus,
- calculate a statistical score for each one,
- rank candidates according to the scores,
- select a predetermined number of the top candidates for manual inspection, and
- confirm the true collocations manually.

Candidate collocations are often word *n*-grams as a contiguous sequence of words usually as bigrams. In the simplest case, the first step involves considering all pairs of consecutive words in the corpus as candidate collocations. In this case, linguistic analysis was applied to identify candidates that follow particular syntactic patterns, e.g., adjective + noun, or verb + noun. Next, there were several possibilities for the statistical score such as ranking by frequency to syntactically filtered data. However, high frequency can be accidental, in which case hypothesis testing was employed as a statistical technique to assess whether or not an occurrence was a chance event. More information about the methodology is given in later sections.

2.3. Soft and Hard Urban Infrastructures

When applying computational linguistic analysis to public participation meta data, a framework is needed to interpret the interests and attributes identified by individuals and groups. Based on previous case studies (Dyer et al., 2019), a framework comprising soft and hard urban infrastructures was adopted. As defined earlier, the term 'soft' referred to public administrative, organizational, and social structures present in a city, whereas the term 'hard' described the physical components of a city that enable the soft infrastructure to function (Dyer et al., 2019). This categorisation of urban infrastructure has been developed further in Table 1 by describing in more

Table 1. Soft and hard urban infrastructures.

Hard Infrastructure	
Utilities	Utilities are considered to be physical services such as transportation, water and waste systems, ICT, etc. These utilities connect and operate equally across all urban scales, including national and international interconnectivity.
Urban Space	Urban spaces are considered to be largely as bounded space, in the form of streets, urban plazas or local squares, playgrounds, parks, etc. Urban space is typically identifiable at the neighbourhood or district scale, depending on the nature of the open space and pattern of land ownership.
Buildings	Buildings are considered to be architectural space defined as single or grouped buildings forming part of an urban block. This will include dwellings, educational buildings, healthcare buildings, etc.
Soft Infrastructure	
Institutional	Institutional infrastructure refers to public and private systems which provide certain services within the city such as local government, legal frameworks including land ownership, healthcare services, or educational services. It may also include sporting, art and culture, or official community support organizations. These institutions are typically top-down and more formal in nature.
Community	Community infrastructure refers to formal and informal networks, community or local business groups that occur within neighbourhoods or districts. These infrastructures rely on bridging and linking social capital. While 'Communities of Interest' or online communities may not be location specific, many community organizations will relate to a specific physical community delineated by political, parish or physical boundaries (a river, large street, etc.). In this regard community infrastructures will often operate within the district scale and arguably at a more identifiable level at the neighbourhood scale.
Personal	Personal infrastructure refers to the support systems a person will have at an individual, family, or friendship level. This will often involve bonding social capital where membership of a family or social group is critical to a sense of belonging. It will also include educational attainment and other support systems that occur at an individual level.

Sources: Grey et al. (2017) and Dyer et al. (2019).

detail types of utilities, urban space, and buildings, and of institutional, community, and personal infrastructures.

At the same time, it is important to recognize that these infrastructures potentially overlap and intertwine at different scales across the city. An appreciation of the relationship between soft and hard urban infrastructures and spatial scale contributes to an understanding of the perspective of different individuals and groups across the city (Dyer et al., 2019). It can help explain the varying interests and positions adopted by different stakeholders. For example, when collecting data from stakeholders, Moughtin and Shirley (2006) contended that public engagement is most effective at the city quarter, or neighbourhood level, as these represent a scale where residents can contribute their local knowledge and expertise. This is because neighbourhoods, quarters, or districts of the city have a somewhat identifiable boundary, recognisable to both residents and outsiders alike. As recognised by Lynch's (1960) seminal work, neighbourhoods are structural elements common to most cities that influence people's perception of the city, thus making the urban environment more intelligible and legible. In addition, most people interact with the urban environment on a daily basis at the neighbourhood scale, and therefore this scale has a significant impact on their quality of life.

3. Methodology

3.1. Software Systems Architecture

As explained earlier, the study adapted the linguistic software tool FLAX (Flexible Language Acquisition) developed by Wu and Witten (2015). This software is capable of analysing large text data sets from public engagement exercises to identify common themes and reoccurring topics of conversation that reflect community interests and desired qualities of soft and hard infrastructures. The software employs syntactic analysis to identify collocations of two or more consecutive words that appear more frequently than random. For instance, the phrase 'shuttle bus' could be identified in a sentence, rather than 'bus shuttle,' as an example of high-frequent word combinations that indicate high-trending topics of interest to people.

The FLAX software overcame the inherent problem of languages having large numbers of collocated words by automatically employing sets of syntactic patterns to retrieve a list of collocation words specific for individual data bases. The collocation extraction heuristic procedure firstly assigns part-of-speech (POS) tags to all the words using the Apache Open Natural Language Processing Library (Apache Software Foundation, n.d.). Secondly, it matches these tagged words with a set of predefined patterns and identifies the collocation words. Lastly, it collects all the collocations, groups them by matched patterns, and sorts them by the frequency usage.

The POS tagging technique identified the collocation word as 'noun,' 'verb,' 'adjective,' 'adverbs,' etc., and labeled it with the corresponding word type. FLAX POS tagging adopted the PennTreebank POS tagset at word level and assigned one POS tag to each word. For example, the collocation 'green spaces' is tagged as 'green/JJ spaces/NNs.' The symbol 'JJ' represents the word 'green' as adjective, and 'NNs' indicates the word 'spaces' as a plural common noun. Later on, tagging information helped with recognition of keywords in contributions from participants.

Taking all these features into account, the Urban Narrative Data Analytics and Visualisation software architecture for analysis of large format data from the Christchurch's *Common Themes* public consultation exercise is illustrated in Figure 2. Using the 300 stories as a sub-set from the Christchurch's *Common Themes* report, FLAX collocation analysis identified sub-categories of soft and hard infrastructures using the 'noun + noun' pattern and the desired attributes from those city infrastructures using 'adjective + noun' pattern.

Starting with the 'noun + noun' patterns, each infrastructure sub-category was encoded as a structured XML to show the text ('text' element), type ('noun + noun' elements [NN]) and POS tag ('tagged_text' element) as illustrated in Figure 3 (left). For instance, the term 'car parks' appears eight times in all story contexts, and the word 'car' is tagged as a singular noun and 'parks' as a plural noun. Each infrastructure sub-category is mapped as either soft or hard infrastructures. Hard infrastructure categories include 'utilities,' 'public space' and 'building,' and soft infrastructures comprise 'institutional,' 'community' and 'personal.' In this case, 'bus exchange' and 'car parks' are associated with 'public space' infrastructure.

Likewise, collocations of 'adjective + noun' patterns were used to retrieve terms describing desired attributes or qualities of soft and hard infrastructures by identifying connections between infrastructure categories. These terms derive from the Flax collocations 'adjective + noun,' 'adjective + to + verb,' and 'adjective + preposition + noun.' Similar to infrastructure categories, terms describing the desired qualities of urban infrastructures are encoded as an XML document where the adjective is denoted as 'JJ.' For example, in the phrase 'green spaces' in Figure 3 (right), the term 'space' belongs to the 'public space' sub-category of hard infrastructure category, and the adjective 'green' describes the desired quality for that infrastructure sub-category.

3.2. Pairing Soft and Hard Urban Infrastructures

Once the respective sub-categories and qualities of infrastructure were identified, individual contributions or stories from public consultation were grouped by pairing soft and hard urban infrastructures. The pairing exercise had three stages, namely (1) building a glossary of terms, (2) identifying pairs of stories with the same sub-categories of soft and hard infrastructures, and sub-

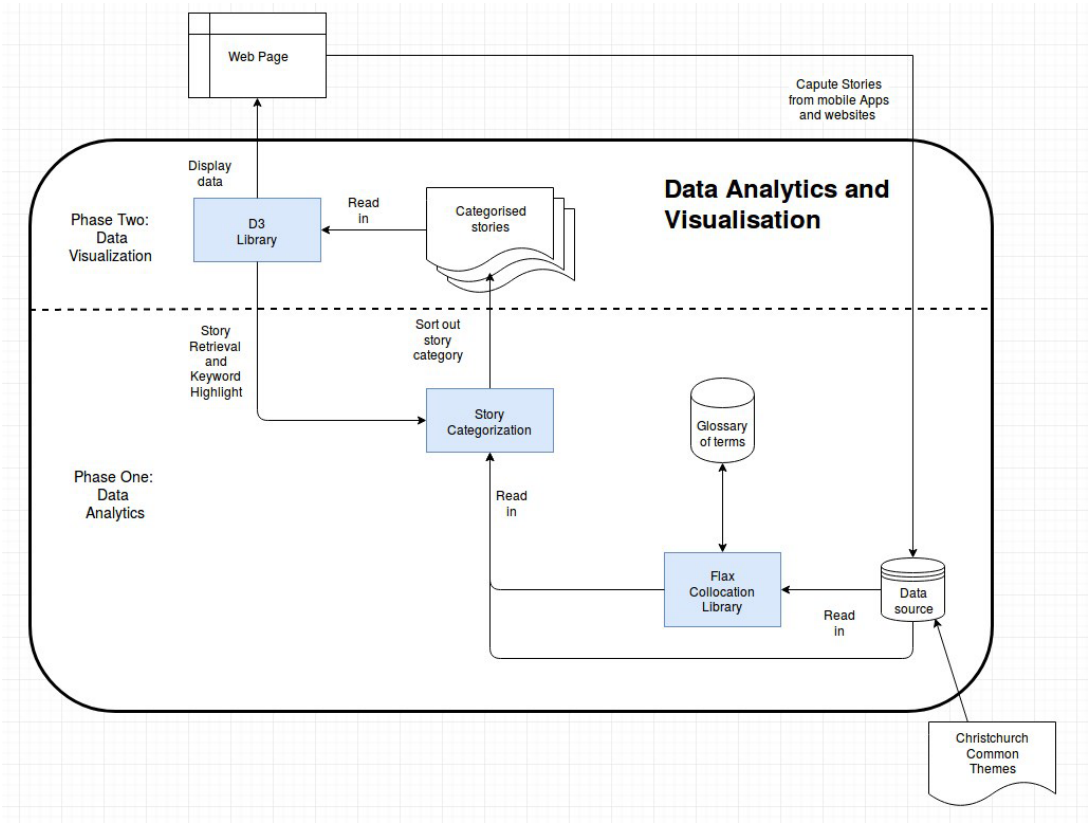

Figure 2. Urban Narrative data analytics and visualisation architecture. Source: Authors.

Figure 3. Sub-categories of urban infrastructures (left); qualities of urban infrastructure (right). Source: Authors.

sequently (3) undertaking statistical analysis, such as counting how many stories are connected with two subcategories. The terms used to establish a glossary for soft and hard urban infrastructures required domain knowledge and expertise in urban design. However, once the FLAX library extracted all the collocated words for the 'noun + noun' and 'adjective + noun' patterns, the terms were listed and examined by experienced urban designers to understand the relative importance attached to different combinations of soft and hard urban infrastructures by the public consultation exercise and expected qualities for those infrastructures to promote greater liveability and livelihood.

Having focussed on the term 'city centre,' the phrase 'bus exchange' was found to be the next most frequently occurring FLAX collocation (noun + noun), as shown in Figure 4, along with other collocations that related to transport (i.e., 'bus exchange,' 'car parks,' 'transport options,' 'shuttle buses,' and 'car parking') that made up a substantial number of stories, 36 in total. Interestingly, the collocations about transport related primarily to two topics, cars (16 stories) and buses (15 stories). In both instances it was the destination/arrival points which were the main topic of discussion, i.e., the exchange and parking areas. While the collocation 'transport options' requires further contextualisation, this supported the finding that 'transport' was the top trending topic amongst citizens of Christchurch in relation to the city centre.

Notwithstanding the top three most frequent collocations, the frequency of the remaining collocations was noticeably less, each attracting between five to four comments. These included references to 'buildings' which relates to five commentaries about building heights, both high- and low-rise. Buildings use was also a topic of discussion, in terms of appropriateness ('sex shops') and physical location ('ground floor') within the city centre. Furthermore, the collocation of the term 'city living' primarily related to discussions around increasing activity within the city centre at different times of day and night through the re-introduction of residential uses.

In comparison, when FLAX investigated the desired qualities or attributes of urban infrastructures by using the collocation pattern for 'adjective + preposition + noun' it revealed 'safety' as being the main topic of interest, as shown in Figure 5. In particular, citizens commented about safety in the city centre ('safety around the central city' and 'safe at all times') and how soft and hard infrastructures could create a safe urban environment, such as the presence of security wardens in the city centre as part of a soft infrastructure. Commenting further on expected attributes of an urban environment, citizens placed a lot of importance on visitors' experience in the city centre ('great for tourists' and 'attractive for visitors'). For example, the collocation of words for one commentary referred to 'to its enhanced function' which related to the retention of tourism through quality public realm. Likewise, connectivity between the city centre and suburbs was considered an important theme in terms of 'interconnecting with the suburbs,' as did the topic of inclusivity in regard of the collocation 'accessible to everybody.'

3.3. Data Visualisation from Public Consultation

Although 300 stories is a relatively small sample size compared to the total number of stories received from the public consultation exercise, analysis of collocations demonstrated the potential for natural language processing and expert knowledge to quickly identify top trending topics, or priorities among citizens in relation to the city centre of Christchurch. The next step was to use data visualisation techniques to explore connections between soft and hard infrastructures. From a review of three well-known tools (D3.js, Google Chart, and vis.js) the open source library D3 (Bostock, n.d.) was chosen for developing data visualisation tools. In particular, chord

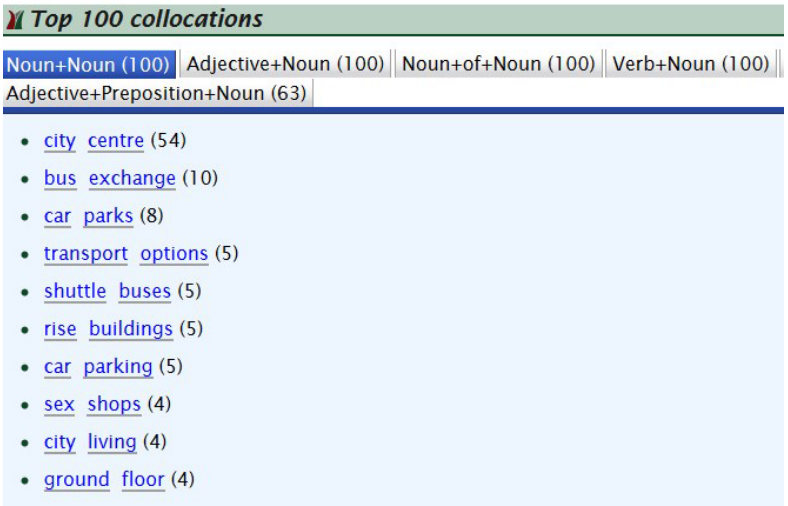

Figure 4. FLAX collocations (noun + noun) for 'city centre.' Source: Authors.

Figure 5. FLAX collocations ('adjective + preposition + noun') for 'city centre.' Source: Authors.

diagrams were used to illustrate inter-relationships between sub-categories of soft and hard infrastructures (Holten, 2006). This was undertaken in conjunction with MarkJS (JavaScript keyword highlight; mark.js, n.d.) to highlight key words in the text of different categories and qualities of hard/soft infrastructure being referred to in the Christchurch public consultation exercise.

Based on this approach, an initial chord chart was produced which illustrated connections between nine different combinations of soft and hard infrastructures. In practice, this was achieved by using multiple single-label classification questions as follows to categorize individual contributions:

1. Does this story use any glossary of term from 'utilities' infrastructure?
2. Does this story use any glossary of term from 'public space' infrastructure?
3. Does this story use any glossary of term from 'building' infrastructure?
4. Does this story use any glossary of term from 'institutional' infrastructure?
5. Does this story use any glossary of term from 'community' infrastructure?
6. Does this story use any glossary of term from 'personal' infrastructure?

The approach produced a list of categorized stories, as shown in Figure 6, where each row referred to one story or contribution along with its associated infrastructure sub-categories ('Category' column) and keywords identification ('Keywords' column). This approach transformed the multi-label to single-label classification which greatly reduced the complexity for the prototype.

Using the output from the CSV file, this led to production of a relationship matrix of an array of six items, where each $mat[i]$ has an additional array of 6 items, and $matrix[i][j]$ represents the number of stories from i-th category to j-th category. Hence the matrix row and column represent 'Utilities,' 'Public Spaces,' 'Building,' 'Institutional,' 'Community' and 'Personal' accordingly. So the 1st row $mat[0]$ represents all the links identified between 'Utilities' with the other five infrastructure categories. $mat[0][1]$ denotes the link from 'Utilities' to 'Public Spaces,' and $matrix[0][5]$ represents the link from 'Utilities' to 'Personal.' However, $mat[0][0]$ is zero as no link from/to 'Utilities' itself. The matrix is bi-directional, so $mat[i][j] = matrix[j][i]$.

4. Findings and Discussion

Based on this methodology, primary chord charts were created from the FLAX analysis of ten stories from the Christchurch's *Common Themes* as shown in Figure 7. A preliminary review of the primary chord chart shows contributions from residents of Christchurch focussed more on hard infrastructures than soft infrastructures, where the sub-set for hard infrastructure attracted 20 in-

Category	Story	Keywords
|Public Space|Institutional	Mix of views on university – some say bring it back into the city centre others say leave it at Ilam.	|Public Space:-city centre-city centre||Institutional:-university|
|Public Space|Building|Institutional|Community	"Some suggest bringing components back into city centre (e.g. Music school, artistic displays, law school, study space, accommodation) ""We really have to be positive about bringing the whole university back into town."	|Public Space:-city centre-city centre||Building:-study space||Institutional:-university-music school-artistic displays-law school||Community:-town|

Figure 6. Snippet of categorized stories CSV file. Source: Authors.

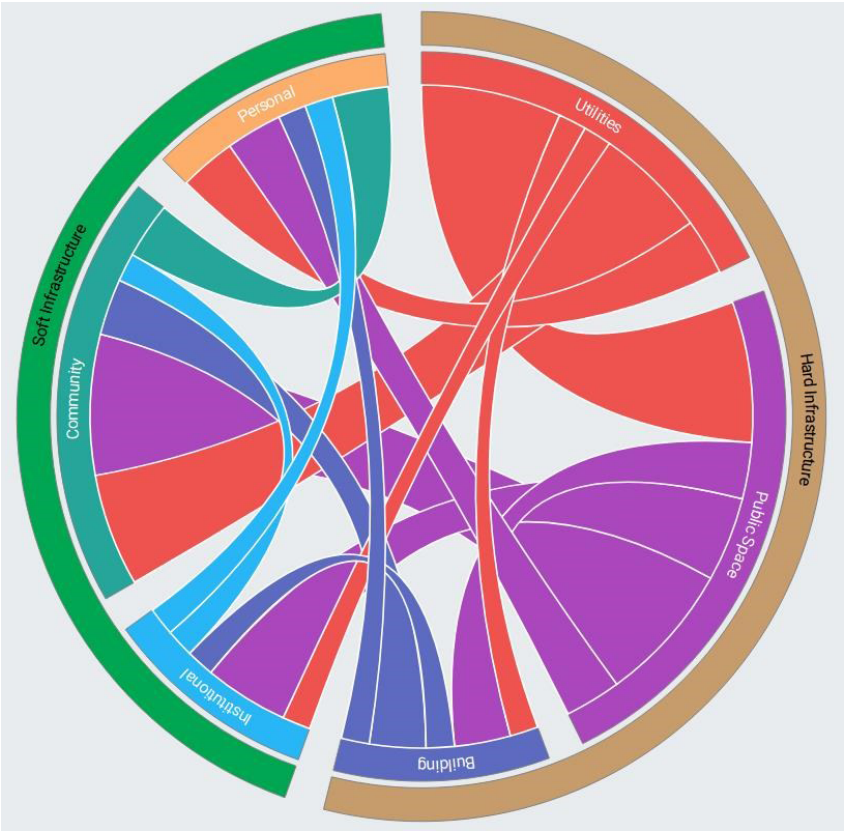

Figure 7. Primary chord chart illustrating connections between soft and hard infrastructures from the FLAX syntactic analysis of ten stories from the Christchurch's *Common Themes*. Source: Authors.

dividual contributions and soft infrastructures 12 individual contributions. In particular, the hard infrastructure category of 'Public Space' attracted the greatest number of contributions as well as the highest number of connections with other infrastructure types. This preliminary result showed that participants in the public consultation exercise placed a great deal of emphasis on the physical infrastructure following the destruction caused by the major earthquake of 2011. The preliminary result also indicated that public space was a top trending topic for the residents of Christchurch and should be a priority for the future development of the city centre of Christchurch.

When exploring the findings in further detail, a secondary chord chart was generated to highlight residents' contributions that referred specifically to one or more glossary terms for the 'Public Space' category. This secondary chord chart is shown in Figure 8. Apart from identifying relationship chords between 'Public Space' and other soft and hard infrastructures, it was possible to retrieve individual stories using the D3.js JavaScript library. Extracts of these individual stories are also reproduced in Figure 9 for the relationship chord connecting 'Public Space' with 'Institutional' infrastructures. The extracts of text show terms referring to 'Public Space' and 'Institutional' infrastructures boxed with adjectives describing desired qualities of infrastructure in green-coloured font. For example, one story refers to police in terms of soft 'Institutional' infrastructure and, in particular, the desire for greater visibility and presence of policing within the city centre. Although these cases referred to hard infrastructure in terms of 'dark,' 'seedy,' 'late,' 'low,' etc., the collocated adjectives indicated a desire for increased personal safety. Hence, an important narrative that emerged from the analysis was 'policing of secure and safe public spaces in city centre.'

Finally, further insights from the text analysis of public consultation were obtained by comparing qualitative syntactic text data from Christchurch's *Common Themes* with quantitative municipal statistical data. Figure 9 illustrates the comparison of the qualitative and quantitative data sets using an infographic display. The smaller font in quotation marks represents core messaging from citizens compared with municipal statistical data shown in larger font size (Christchurch City Council, 2019). The example illustrates one approach for bridging the gap between bottom-up and top-down processes by comparing qualitative public opinion in relation to quantitative statistical data. In this case, the topics ranged from public transport usage to provision of street lighting. Even though the infographic draws upon a relatively small data source, it demonstrated the capacity of infographics to integrate bottom-up and top-down perspectives to create a more holistic Urban Narrative. As such, it is a potentially powerful tool to facilitate a deliberative discussion and collaborative approach towards decision-making that is evidence-based.

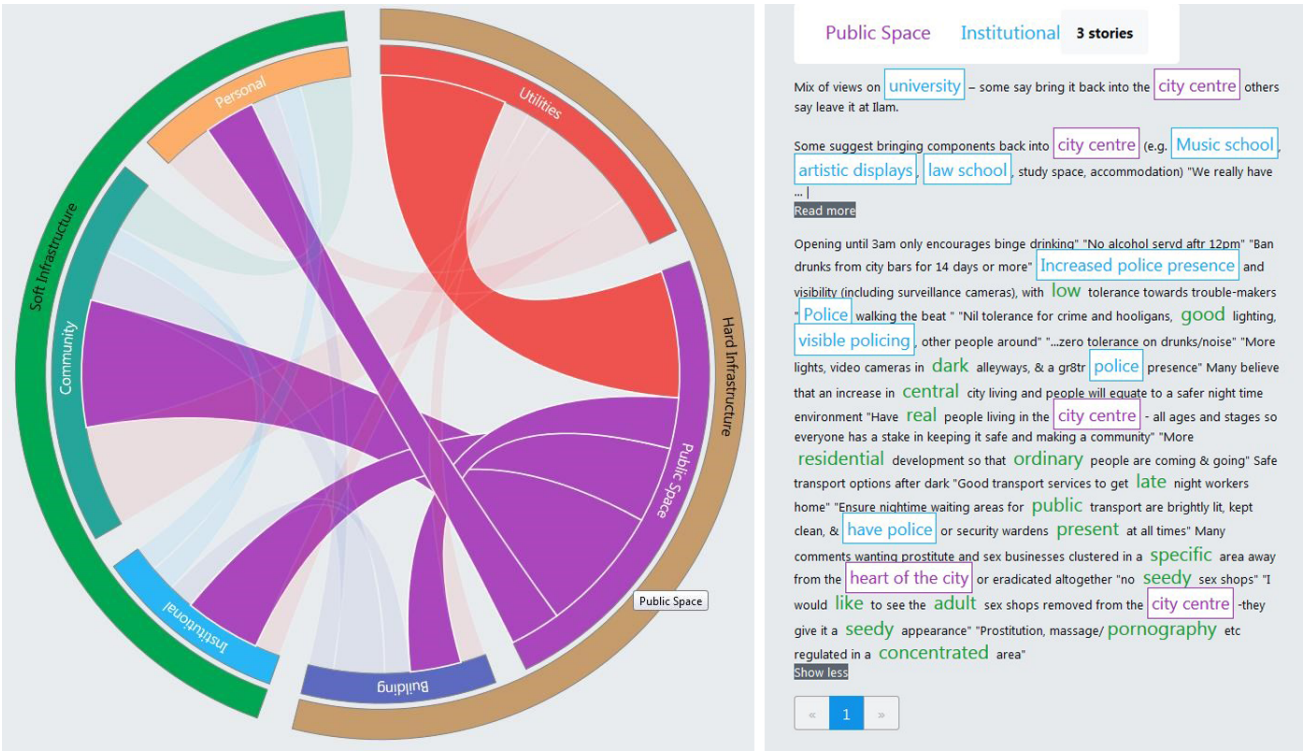

Figure 8. Secondary chord chart illustrating connections between soft and hard infrastructures under the category of 'Public Space' with associated stories shown alongside from the Christchurch's *Common Themes*. Source: Authors.

Figure 9. Infographic comparing qualitative syntactic information from Christchurch's *Common Themes* with quantitative statistical municipal data. Source: Authors.

5. Conclusion

The United Nations estimates that 68% of the world's population will be living in urban areas by 2050 (United Nations, 2018b). To facilitate greater social inclusivity as well as creating built environments that promote improved liveability, there is a need to transfer the digital skills and technology from social media and e-economy to create a step change in collaborative processes for urban planning and design that captures the underlying interests of individuals and communities. There is still a place for traditional consultation processes using 'town hall'-style meetings and charrettes but digital tools offer an opportunity to upscale participatory design methods in response to an increasingly complex urban system to ensure future inhabitants have access to "safe and adequate housing, clean air and basic services and live in resilient and sustainable communities." (United Nations, 2018a)

In response, Urban Narrative has been designed to develop shared narratives about individual interests and desired attributes for urban infrastructure. The inspiration arose from the successful use of common narratives at the Scandinavian cities Växjö and Sønderborg to motivate transition towards becoming fossil-free conurbations beyond land use planning horizons and political cycles. As such, it differs from the participatory mapping of PPGIS by aiming to integrate contributions from individuals into data storytelling.

With those aims in mind, the linguistic software FLAX has been shown to be a powerful digital tool for identifying issues of importance for residents and how those issues could translate into improved services by better connecting the soft communal and institutional infrastructures of a city with the physical fabric of the city in terms of utilities, buildings, and public spaces. The approach supports the old paradigm that the physical infrastructures are a "means to an end and not the end in themselves." Yet there is often too little research and knowledge about the social benefits of infrastructure, or post-occupancy evaluation of built infrastructure to understand the mutual benefits for improved livelihood and liveability. For example, the case study showed that improved safety and security was deemed highly important by individuals, and hence required a coordinated response that connects soft infrastructures (policing) with hard infrastructures (late night public transport, better lit and monitored alleyways and public spaces).

In conclusion, Urban Narrative as a concept functions at the interface between public participation for democratic processes and participatory design for products, place-making and services. It has demonstrated the potential benefits of using computational linguistics to identify individual interests in relation to desired attributes of soft and hard urban infrastructures. Hence, it has the ability to harness the collective knowledge of individuals to understand not just *what* people want, but also *why* they want it, and has the potential to shift design thinking by enabling higher quality design that effectively meets the needs of citizens.

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Conflict of Interests

The authors declare no conflict of interests.

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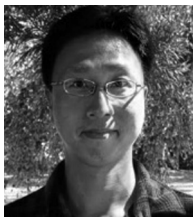

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Article

Designing for Inclusivity: Platforms of Protest and Participation

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Abstract
This article offers critical insights into new digital forms of citizen-led journalism. Many communities across western society are frequently excluded from participating in newsgathering and information dissemination that is directly relevant to them due to financial, educational and geographic constraints. News production is a risky business that requires professional levels of skill and considerable finances to sustain. Hence, 'hyper-localised news' are often absent from local and national debates. Local news reportage is habitually relegated to social media, which represents a privileged space where the diffusion of disinformation presents a threat to democratic processes. Deploying a place-based, person-centred approach towards investigating news production within communities in Cornwall, UK, this article reflects on a participatory action research project called the Citizen Journalism News Network (CJNN). The CJNN is an overt attempt to design disruptive systems for agenda setting through mass participation and engagement with social issues. The project was delivered within four communities via a twelve-week-long journalism course, and a bespoke online app. CJNN is a platform for citizen journalists to work collaboratively on investigating stories and raising awareness of social issues that directly affect the communities reporting on them.

Keywords
citizen journalism; digital innovation; disruptive networks; online platforms

Issue
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1. Introduction

The long hailed digital dawn of the Internet where all voices are equally well-received within an egalitarian framework, and all available channels of representation for participation are clearly signposted, appears to have been delayed and overshadowed by the desire to secure profits through proprietorial systems that enforce subscription models of access. The tools are available within Europe and beyond to enable an effective and proportional representation of the population via Internet connectivity, however, incentives for individuals to participate in public debate are few in a habitus conditioned by a paradigm of exclusionary cultural communicative traditions and the rip-tides of popular public opinion and propriety that surround, depend upon and rigorously defend the status quo. Innovative and socially disruptive systems that emerge are (more often than not) both facilitated by and in response to specific sets of economic and cultural frameworks.

The global financial crisis of 2008/9 precipitated in many western economies the introduction of austerity measures across public social programmes. Governments attempting to address the effects of financial precarity and meet the growing demands of diverse societies have encouraged organisations and agencies to develop and deliver digital social innovations to ameliorate a range of social issues. Although there is considerable debate about the meaning and use of the term social innovation (and overlaps with other activi-

ties such as social enterprise and the social economy), it broadly refers to the ways in which human societies adapt to meet new challenges. Contemporary debates about collective responses to a range of social issues reflect the ways in which human societies both create and adapt to new challenges, experimenting with policy and practical innovations in order to solve collective concerns (Moulaert, Mehmood, MacCallum, & Leubolt, 2017). Hyperlocal-news reporting is one such innovation. In this article we respond to Hess and Waller's (2016) appeal to resituate research on hyperlocal-news reportage within alternative frameworks. We argue that citizen journalism provides an opportunity for publics to engage with local democracy and the politics of the public sphere (Harte, Williams, & Turner, 2017). This is achieved through the deployment of a co-designed digital social innovation (DSI) platform: Citizen Journalism Network (CJN). In the following section we discuss how DSIs can contribute to social change before going on to explore their role in citizen journalism.

2. Digital Social Innovations

DSIs are presented as a way of harnessing the operative possibilities of the Internet to: (1) encourage dynamic social relationships between previously separate individuals and groups; (2) meet pressing unmet social needs and improving the lives of people by drawing publics into the problem-solving process (Edwards-Schachter & Wallace, 2017; Mulgan, 2006); and (3) help organisations to adapt processes or respond to new issues in a flexible and pragmatic way.

The range of DSIs is astonishing, from collectivising people who have similar issues from health, economic and social concerns (Evans & Gawer, 2016; Mason, Barraket, Friel, O'Rouke, & Stenta, 2015; Moulaert et al., 2017) via social networks (Muller & Peres, 2019), to online platforms for citizen participation in policymaking (Angelidou & Psaltoglou, 2017), to using 'big data' or open data sources to produce more transparency around public spending to participatory budgeting (Bria, 2015). This growing interest in DSIs is generally associated with the potential power of civil society and community-led action to develop responses to urban social concerns (Moulaert, Swyngedouw, Martinelli, & Gonzalez, 2010). Rather than calling on government to act for people, as was common during the social democratic experiments of the twentieth century, particularly in Western Europe, the emphasis now is on public engagement through co-design. DSIs are essentially "a type of collaborative innovation in which innovators, users and communities co-create knowledge and solutions for a wide range of social needs exploiting the network effect of the Internet" (Schon, Ebner, & Hornung-Prahauser, 2017, p. 1).

DSI is often cited as a fast fix or panacea for the challenges facing societies, through delivering improved quality of service and operational and cost-saving efficiencies (Dodd, 2015; Lloyd, Jochum, & Hornung, 2017). They are also often predicated on the production of platforms through which organisations, agencies and individuals can connect to each other. To date, platforms have mainly been approached as a phenomenon, rather than as a metaphor or an analytic for social form. Formally, platforms build upon but are—in important ways—distinct from networks, most notably through their 'programmable space' that can be made to perform differently according to how external networks engage. Just as networks indicate the importance of form for understanding the socio technical, DSI platforms must also be approached as a heuristic for understanding the form of social relations.

Regarding urban digital futures, DSIs have the capacity to produce and augment new material and social organisational arrangements. This approach requires the co-design of DSI platforms, but also includes broader materialisations of the social forms of platforms. Across Europe there have been a range of DSI projects aimed at encouraging cities to work together through a network of knowledge exchange and digital practices, such as the CAPS (Collective Awareness Platforms for Sustainability and Social Innovation) programme (for a detailed review of these projects see Bria, 2015; Cangiano, Romano, & Loglio, 2017). The case study of this article, Cornwall, is part of the UK Digital Strategy (Department of Culture, Media and Sport, 2017) and the UK's Civil Society Strategy (Cabinet Office, 2018), which promotes digital technologies to address social challenges. The UK government is "committed to bringing together digital and civil society" (Cabinet Office, 2018, p. 83) through the triple helix approach whereby the voluntary, private and public sectors work together to deliver DSI.

This article examines critically the role and function of DSIs within citizen led journalism. It is within the uncomfortable and challenging interface between individual actions and the collective responsibilities of societies at large that the citizen journalist identifies, observes and reports on their situation(s) of interest, often proactively both inhabiting and responding towards issues of personal interest and personal experience. There is also an active and ongoing dispute between the ethically liberated and financially unfettered actions of the citizen journalist and the industrially embedded and ethically rooted authorial attributes of the professional journalist (Forde, 2011; Williams, Harte, & Turner, 2015). The direct first-hand experiences of the citizen journalist may ensure they are incapable or uninterested in adhering to the traditional journalistic behaviours that attempt to ensure impartial and unbiased reporting. The Citizen Journalism News Network (CJNN) project detailed in the next section applies Downing's (2001, p. 388) "hexagon of radical media" as a guiding framework to encourage the engagement of citizen journalists within the essentially polarised and unresolved spaces between the social and the individual or the personal and the public.

3. Digital Citizen Journalism as Place Making

The advent of digitally networked systems for the creation and dissemination of news media have upended the traditional news practices of national and local professional news providers (Anderson, Bell, & Shirky, 2012). Claire Enders' (2011) report to the Leveson Inquiry in 2011 found that revenues for local news provision have dropped from between 23–50%. This has resulted in an increase in the provision of franchised news services and the subsequent reduction of local narratives and references to place within local news. As Williams et al. (2015) suggest, much of the output of UK hyperlocal news provides an opportunity for local citizens and community groups to contribute to the plurality of local media through reporting on cultural and civic life, local economies, as well as local politics.

Digital technologies have generated an exponential number of two-way access points for a news system that was previously considered to be a closed circuit. Globally networked social media platforms have shrewdly interpolated the opportunities that contemporary communication technologies present to their users whilst at the same time adroitly capitalising upon the demand for digitally mediated interpersonal communications and the new set of creative communication options (Papacharissi, 2014). "The rise of algorithms and platforms that enable individual users and services to take part in publishing news has changed gatekeeping selection processes and news flow patterns" (Wallace, 2018, p. 275), placing a number of international technology companies in the position of being market leaders in global communications and bequeathing them the position of gatekeepers to global, national and local news markets that often treat borders as invisible, content as non-exclusive, news brands as interchangeable and traditional news organisation's business models as antiquated.

The up-shift from inert consumers of the news to active commentators, contributors, distributors and creators of the news has opened up manifold possibilities to study emerging behaviours, relationships and discourses (McCollough, Crowell, & Napoli, 2017). The CJNN project applied iterative design methodologies to create a hyperlocal, networked, news gathering platform as a tool for listening to marginalised members of rural communities within Cornwall. The starting point was the desire to engender agency and personal representation within a series of identified hyper-local minority communities within Cornwall that have traditionally been excluded from or unable to take up such opportunities.

4. Case Study Area: Cornwall, UK

Cornwall is one of the poorest areas of the UK and has seventeen areas that are ranked amongst the most deprived 10% in England (Cornwall Council, 2015). Since 2000 Cornwall has received £350 million in funding from the European Union via the Objective 1 programme to boost the economy and ameliorate the worst extremes of severe deprivation (Cataldo, 2016). Those who financially struggle in Cornwall face a range of types of exclusion, digital, financial, social and wellbeing, leaving vulnerable groups behind (Dwyer & Wright, 2014; Turnbull, 2016). Digital exclusion is a social problem as much as a technological one, making it hard to access services online, including Universal Credit (Cornwall and Isles of Scilly Leadership Board, 2019). Financial exclusion follows from digital exclusion, as those most vulnerable are excluded from managing monies online (Travers-Smith, 2016). Social exclusion and isolation are increasingly recognised as threats to wellbeing and resilience in terms of health (Age UK, 2015). The rural geography of Cornwall and relatively poor availability and affordability of public transport compounds this isolation. Data on low wellbeing presents a worrying picture for Cornwall in terms of the economy, employment and wages, education and housing.

The CJNN project received funding from the European Social Fund delivered through the "Widening Participation through Skills" partnership. Funders required targeted involvement from within disadvantaged marginalised demographics from inside 'cold-spot' areas within Cornwall (European Social Fund, 2017). Cold-spot areas were identified as geographic regions where the uptake of places at level 4 of education were below national average. Marginalised and disadvantaged participants were identified as being from within the following demographic categories:

- Employed females
- Participants aged 54 and over
- Participants from ethnic minorities
- Participants with disabilities
- Single adult households with dependent children

In total the researchers worked with 67 people.

5. Practice and Method: The CJNN Project

The CJNN project did not adopt the tenet that impartiality is a prerequisite for journalistic reportage to be of value to society. Evidence of so-called unbiased 'professional' reportage is nothing more than an elaborate panacea deployed by commercial journalists to buttress against a public's clarion call for objectivity in the face of the central objective truth that all words selected and written by any individual at any time can only, by design, represent a subjective truth. This questioning of the central raison d'être of professional journalism through co-design is not explicitly intended to undermine the institutions and individuals who conduct a crucially important role in society through fulfilling the Sisyphean task of investigating and attempting to communicate external facts through a specific medium in the hope of inculcating a more balanced and informed society. The

CJNN project simply attempts to throw the responsibility for attaining and evaluating such highly principled aims and aspirations firmly back into the realms of the social through DSI and co-design inspired collaborative-authorship practices.

The CJNN hypothesis proposes that through foregrounding interesting new ways to generate co-authored news items via a bespoke DSI platform the research could relieve citizen journalists from some of the pressures and financial incentives of traditional journalism, e.g., having to be the first to publish a story, or to become the lone subject-specific expert/author within a defined journalistic field. The CJN app is an attempt to engage with some of the core issues described within this article through the implementation of iterative development processes to build a participatory platform through utilising representational state transfer (REST) application programming interface (API). Also known as RESTful web services, the REST API provides a file storage and retrieval system that is built upon a protocol that facilitates interoperability between different computer systems. The REST API system architecture allows for multiple points of access to the storage of data through different hierarchical levels of user privileges depending on the anticipated functionality of the app/website or database. Importantly REST APIs also facilitate synchronous access to the data stored on the system, which provides the ability for the system to grow while it is being accessed by multiple users.

Inherent Rest API infrastructural characteristics allow for collaboration between the citizen journalists but in order to fully realise the collaborative potential of the infrastructure the designers were required to develop an externally facing user interface that supported the intended practices. The CJN app integrated the Rest API characteristics into the user interface through labelling the forward-facing individual component media parts, such as images, text and metadata that come together to make up a journalism story as discreet 'fragments' (Figure 1). Within the app, fragments have the ability to be selected individually or configured into story 'clusters' by either the user or the audience. Individual fragments can be construed from various media types such as text, sound, images, films, and metadata, e.g., geographic location, tags, etc. (Figure 2), and each fragment represents one facet of the overall story, therefore the CJN app stores the fragments in a format which represents the story in a permanently unfinished state of becoming.

Users are able to assign story fragments to an identified, independent yet related story clusters that facilitate the aggregation of multiple fragments into thematic associations. Therefore, story fragments can be browsed as discrete objects by an interactive user as well as experienced from inside a collective format. Fragments and clusters may also be shared, assigned additional qualities and contributed towards by other users. The specific qualities of this collaborative ownership model of production are a deliberate incitement to disrupt the

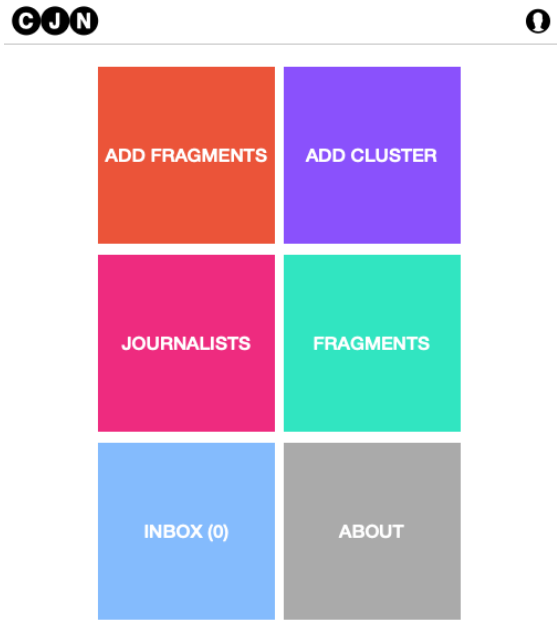

Figure 1. CJN home screen.

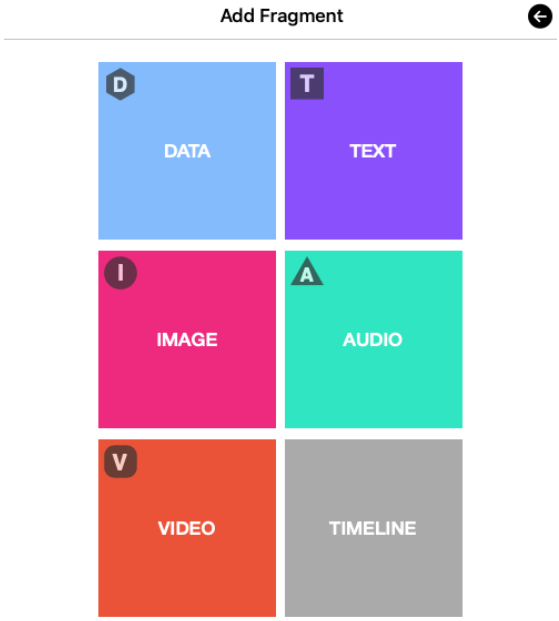

Figure 2. CJN fragment upload screen.

hegemony of the 24-hour news cycle within industrial news production. Through encouraging citizen journalists to contribute towards a shared story within an ongoing networked framework the CJN app provides an enticement to return to the story as the cluster expands over time as more citizen journalists contribute to the story. In this way, new industrial practices begin to assuage audience concerns around any perceived lack of journalistic impartiality through allowing a networked cluster of citizen journalists a participatory authorial role in the production of a story. Providing a networked oversight of story production facilitates greater

levels of credence and believability through proffering multiple subjective viewpoints upon a single objective phenomenon. A similar methodology was successfully applied within the 2017 fact checking project called CrossCheck when 100 journalists from newsrooms around the globe monitored and collectively debunked false information around the French general election (Smyrnaios, Chauvet, & Marty, 2017).

For members of the public consuming the forward facing CJN website (Figure 3), journalistic output can be accessed in a manner of their own choosing, for instance audiences can listen to a sound recording whilst looking through sets of images or data visualisation or reading some text on the subject. Rather than being associated with time-based news proliferation it was anticipated that using the CJN website would be similar to browsing an online archive. Researchers were interested in understanding to what extent innovative design could facilitate co-authorship and promote a fresh journalistic heterodoxy.

6. Creating the News: Creating Places

Journalism has a long history of identifying and commenting primarily on local or national issues and being supported through local/national business markets however the primary focus on local/national cultures has been reconfigured via the digital shift towards a more global/US-centric reframing of audience interests. The desire to engage with local and hyper-local interests remains a strong impulse within local communities however the ability for larger organisations to control the news agenda with more sensational international stories is compelling to audiences and steers finances away from local news production causing a significant reduction in local news production (Boczkowski & Mitchelstein, 2013). The globalisation of professional news agendas provided motivational considerations for members of the CJNN cohort as evidenced by this quote from one of the participants:

> From the hyperlocal to the universal, the CJ could offer an alternative, thoughtful, authentic, contrary yet healing space for a creatively disruptive conversation between people where we, with care, listen to and tell our own and others' stories—with the purpose of cleaving the truth, as far as we can tell—from the spin, the hyperbole and the vested interest, as long as we understand and accept that we are just as vulnerable to such toxins as any other journalist.

Mobile computing and smartphone functionality offer citizen journalists multiple opportunities to substantiate their journalism claims through supplying the geo-locative metadata associated with their fragments. Geographic identification provides audiences and local media partners with the opportunity to browse stories from within their own geographical communities, allowing audiences to identify the scope of issues as they pertain to their own communities thus reconfiguring national stories within narrower local or regional frameworks. Perhaps more importantly, geolocating stories

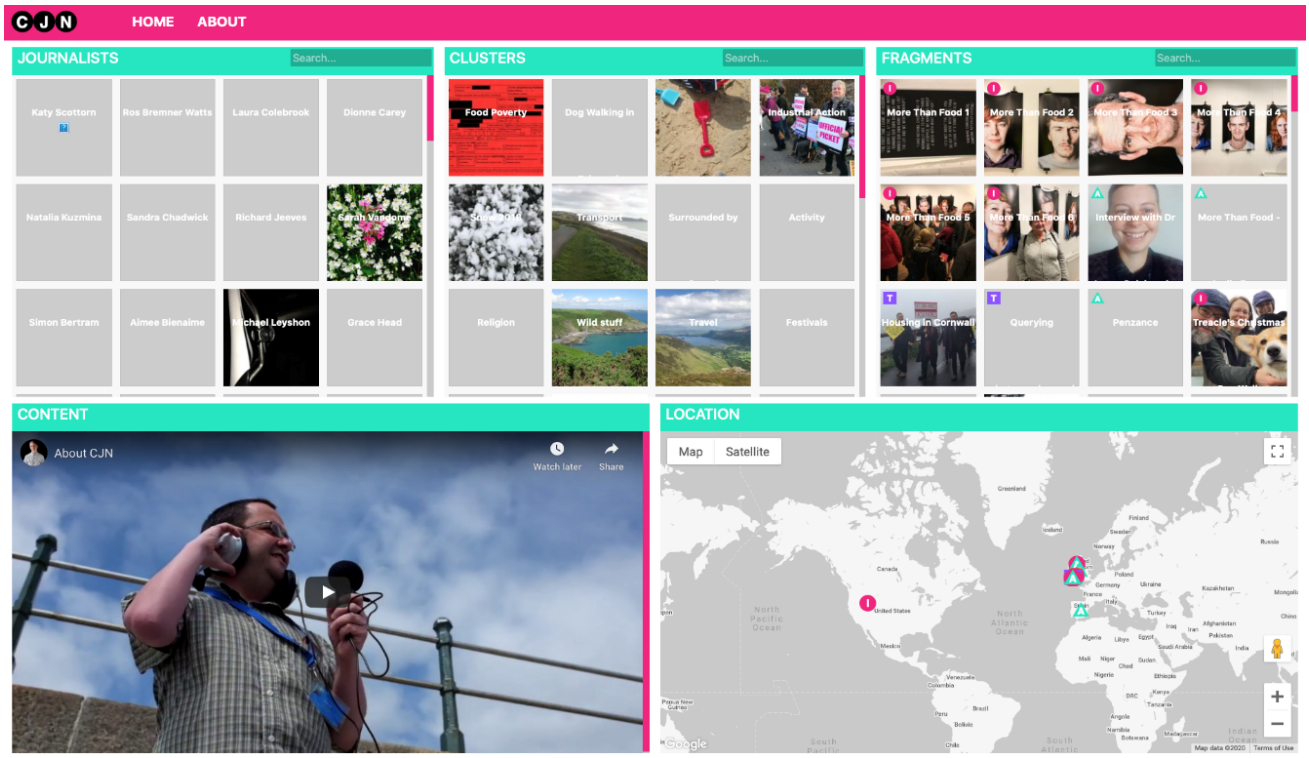

Figure 3. CJN website homepage.

helped to facilitate opportunities for participants to identify place-based, person-centred approaches towards acknowledging and making visible specific issues of direct and significant importance within their own lived experiences from inside a knowable, hyper-local geographical framework. The research team operate within an ethical framework that dictates that an individual's specific geographic conditions and related opportunities and obstacles are an important defining factor in specifying their individual outlook, experiences and interests. Concrete practical examples of the place-based person-centred application of CJN related DSI are available within the geotagged artefacts uploaded to CJN website. In one such example a CJN user investigated the gentrification of small Cornish harbour town called Porthleven through first-hand experiential reportage (Osborne-Dowle, 2018) and in this way the CJNN project can be seen as an extended and ongoing application of a Participatory Action Research method by placing the participant at the centre of the decision making when selecting and identifying the issues of primary importance to themselves through reporting on their own lived situation.

Designing and developing large scale interactive communication platforms necessitates a detailed, subject-specific understanding of the required call to action points and ongoing engagement motivations of potential users. Citizen journalism attracts a wide range of participants from professional journalists to complete beginners and inside each citizen journalist exists a complex range of personal motivations for instigating an involvement with a specific journalism project (Barnes, 2016). Whatever the motivation, every citizen journalist whether they know it or not is interested in entering into some form of reciprocal arrangement, which could be emotional reciprocity in the form of praise from their community and peers, or it could be practical forms of reciprocity such as improved employment opportunities, or it could be a form of philanthropic reciprocity achieved through witnessing personal stories come to life and facilitate positive change within communities (Borger & van Hoof, 2016; Lewis, Holton, & Coddington, 2013; Wall, 2017).

Understanding users' expectations around reciprocity and other forms of direct or indirect feedback are vital considerations when designing communication platforms (Harte et al., 2017). However, the designers of the CJN app were committed to attempting to avoid some of the familiar forms of incentive driven feedback loops that facilitate and encourage addictive and morally questionable behaviours within corporate platforms. Rather, the CJN platform was explicitly designed to encourage and enable the co-production of news stories, eschewing the inclusion of many well-known social media design practices that offer users a momentary sense of engagement and affirmation such as a 'likes' and other badge notifications. Instead, there was expectation that satisfaction and a sense of reciprocal engagement would be available through collaborative practice, networking and the wider dissemination of story fragments through an explicit partnership connection with professional and community broadcasting organisations.

However, the ability to share story fragments and clusters with a wider community outside of the app infrastructure was deemed to be of critical importance to the reciprocal principles of the project. Upon reflection, the noble ideals and creative restrictions upon which the design and development stages of building and testing the CJN app are operating were not supported by sufficient primary research with the intended users. This may have resulted in a lack of ongoing engagement with the platform once the CJNN project had completed. Attempting to design platforms against established reciprocal paradigmatic frameworks that exist within popular multinational social media platforms was overly optimistic and representative of a somewhat hubristic idealism on the part of the development team.

The research applied a mixture of content analysis, textual analysis and narrative analysis methods to enable a close reading of the texts submitted within the CJN app. The content analysis was cross-referenced against additional data fields including geolocation information as well as any perceived cluster associations that are made available through the author 'tagging' content with categorical field information. Interrogation of the content submitted to the CJN app alongside the geographical context within which that content was submitted enabled researchers to specifically assess the textual qualities of the fragments and identify and record any references to, or lack of reference to, the following relevant textual, narrative and geographic themes:

- Hyper-local/local/national or international references of place.
- A direct reference by the citizen journalist towards a personal interest or involvement with the chosen subject matter.
- An address by the citizen journalist towards an identified community that exists within a geographic framework that can be considered as local to the reporter.
- An address towards an identified community that exists within a geographic framework that can be considered as international.

To minimise the range of potential interpretations on offer the research applied categorical stipulations for each of the textual/narrative themes. Hyper-local/local/national or international references of place are measured straightforwardly in the following ways:

> Category 1(A). Any text which contains imagery, sounds effects, verbal or written mentions of a 'hyper-local' environment = any text that is identifiable as falling within a 5-mile radius of the journalists lived environment. An example of this is where the journalist states: "We have looked into the history of the

Penzance promenade and why it is not used to its full potential since completion in 1893."

Category 1(B). Any text which contains imagery, sounds effects, verbal or written mentions of the 'local' environments = any text that is identifiable as originating from within Cornwall but outside of the 5-mile radius 'hyper-local' definition geographic boundaries. An example of this is where the journalist states: "I decided to talk about ocean pollution and the visible effects that it has to Cornish beaches. Through my research I had noted that many beaches outside of my local area had planned many beach clean-up events where the public was encouraged to go and clean the beach in an organised group."

Category 1(C). Any text which contained imagery, sounds effects, verbal or written mentions of a 'national' environments = any text that is identifiable as originating outside of Cornwall but still geographically identifiable as originating from within the UK. An example of this is a piece by citizen journalist Tracey Johnson on the CJN app where Tracey interviews someone in Birmingham about music culture (Johnson, 2018).

Category 1(D). Any text which contained imagery, sounds effects, verbal or written mentions of an 'international' environment, meaning any text that is identifiable as originating outside of 'national' UK boundaries is considered to fall within this category. An example of this is a piece by citizen journalist Rob Shapland-Hill (2018) on the CJN app where Rob spends a day exploring the city of Cartagena in Spain.

In order to qualify as a direct reference towards a personal interest or involvement with the chosen subject matter by the reporter, the researcher would be expected to have been able to identify, either through the texts or associated reporting on the subject matter, a directly citable source where the journalist makes a claim towards a direct and personal relationship with the subject matter. A powerful example of this is available in the piece on domestic violence called "#Survivor" (Richardson, 2018) on the CJN website.

Subjects of interest to the wider community local to the reporter is a more speculative category. This is an attempt to differentiate and identify a journalistic address towards a local audience through selecting a subject matter that can be rationalised as being of interest to a local audience but not of interest to a national or international audience. It could be argued that this category is simply a reframing of the 1st category however it was felt that the slight reframing of the research question could allow for a more nuanced interpretation of the data.

The results of the content analysis (Table 1) point towards some interesting trends and dynamics within the study group of 67 people.

There was a strong propensity to create journalism that contains (either) imagery, sound effects, verbal and/or written mentions of a 'hyper-local' environment with over 66% of the work submitted falling within category 1(A), including fragments such as John Pestle's (2018) short report about a housing march from Newlyn to Penzance. Perhaps unsurprisingly the percentage of the study group utilising a direct mode of address towards an identified local community (62%) almost directly mirrors the percentages for mentions of a hyper-local environment, fragments from this category included fragments such as David Hill (2018) reading a community noticeboard for West Penwith. However, 46% of the work submitted also contained either imagery, sounds effects, verbal and/or written mentions of a 'local' environment with fragments in this cate-

Table 1. Results of the content analysis of CJN fragments.

Categories and Definitions	Number of instances stories of this categorisation were submitted to the CJN app
Category 1(A) = Any text which contains imagery, sounds effects, verbal or written mentions of a 'hyper-local' environment	23
Category 1(B) = Any text which contains imagery, sounds effects, verbal or written mentions of a 'local' environment	16
Category 1(C). Any text which contained imagery, sounds effects, verbal or written mentions of a 'national' environment	10
Category 1(D). Any text which contained imagery, sounds effects, verbal or written mentions of an 'international' environment	12
A direct reference towards a personal interest or involvement with the chosen subject matter by the reporter	16
Direct address towards an identified local community	22
Direct address towards an identified international audience	4

gory including John Pestles image from a Save the NHS Rally in Truro (Pestle, 2018). However, only 29% of the work submitted referenced national environments and an example of a fragment from Category 1(C) include work such as Neil Berry's (2018) news report from his "Easter Podcast." 34% of the work referenced international environments however this was always associated with personal travel and/or historical experiences of living inside those international environments, such as Rob Shapland-Hill's visit to Cartagena in Spain. Almost 50% of the members of the study group made a piece of journalism that in some way makes a direct reference towards a personal interest or involvement with the chosen subject matter by the reporter such as Sarah Vandome's piece titled "Tregassic Winter Walk" (Vandome, 2018). As with mainstream news outlets the work submitted through the CJN app falls into the categories of either 'hard' or 'soft' news. The hard news submitted via the CJN app provides a number of examples of what we would categorise as 'protest journalism' as evidenced by the work submitted by Osborne-Dowle (2018), Pestle (2018) and Richardson (2018) that challenge the established and more normative mainstream discourses used in place-making.

The content analysis draws attention to the ability of using the predominantly hyperlocal focus of citizen journalists as a method for challenging the predominantly national and international focus of mainstream media outlets. The CJN platform uses issues-based reporting as a DSI to identify a geography of what matters in peoples first-hand, person-centred experiences. Geographic distances often dislocate the majority of an audience from the core focus of an international and nationally focused news agenda. National and international issues and national/regional modes of news address are significantly more challenging for citizen journalists to conceptualise and meaningfully reproduce. Therefore, there is a disjuncture between broadcast news that simply coerces audiences into large scale international and nationalistic discourses, and localised forms of self-produced news that serve to empower hyperlocal communities. DSI improves opportunities for representation and de-centers the politics of news and news mediation.

7. Discussion

Some of the broader intentions of the CJNN project cannot be claimed as having achieved success within this iteration phase, for example there was very little evidence of the app facilitating collaborative authorship despite the explicit design intentions to foster precisely this type of behaviour. Also, no research has been undertaken at this stage to evaluate whether audiences of any of the journalistic output of the project felt concern or reassurance around the lack of objective impartiality of the journalism that they were consuming via the CJN website due to the open-source, non-professional, collaborative authorial potential of the CJNN project. There was some evidence of participants revisiting story themes and clusters over a longer period to contribute new story fragments towards the development and deepening of existing story clusters and therefore broadening the discourse around a newsworthy subject in a way that could be considered as contrary to the established 24-hour news cycle, an example of this can be found in the way that CJNN journalist Christiana Richardson (2018) contributed multiple items to the cluster on domestic violence over a four month long period, however it would be tenuous to claim these rare and isolated examples as evidence of an emerging new journalistic heterodoxy.

We set out in this article to explore how DSIs offer the possibility for (urban) places to become more participatory and equitable (Phills, Deiglmeier, & Miller, 2008) through providing a framework for citizen journalism to flourish in contingent places such as pubs, landscapes, shops and social media (Wall, 2017). The CJNN digital intervention offers people living in economically deprived places the opportunity to produce their own news content and diverge from more traditional national media sources. Such localised forms of meaning and place-making are produced by gathering and sharing stories, images, and sounds. Platforms provide a site for the reproduction of place, in the case of the CJN app it was a focal point to address local issues and concerns. This presents several challenges for digital social innovators. Platforms host a range of individual and institutional aims, objectives and contexts that vary in considerable ways. Managing different expectations of actors may become problematic. DSIs like the CJN app can support 'soft' rather than radical change, in which small scale action is grounded in local places. Thus, programmes like CJNN have a disruptive power that enables individuals to bring their interests, concerns and knowledges together in inventive, reciprocal, and collaborative ways.

This research draws attention to the latent need for hyperlocal-news reportage, especially for marginalised groups whose voices are often absent in the mass media. Indeed, hyperlocal reporting is one way of engaging individuals to question the authority and 'trustworthiness' of news (Harrison, 2017) through creative, authentic and issues-based reporting. It also provides, via the CJN app, a new platform for the geography of news that matters in people's lives. The CJNN digital invention makes this possible by offering a person-centred approach to news mediation. However, this does not result in the overwriting of other news sources, rather it becomes part of a more complex local ecology of news production, social media and discourse that reconstitutes notions of community and belonging. These new emergent ecologies could provide a fruitful area for future research on DSI.

While there has been a push for evidence-based approaches to the integration of localised forms of knowledge in formal academic assessments, positivistic science still devalues local knowledges and does not recognize its centrality in the ongoing process of adaptation to major issues. Too often, news stories re-enact the

extractive nature of national media colonialism through the dominance of what is deemed worldview worthy by writing on behalf of local communities. We argue that explicit attention needs to be paid to differential story-telling strategies, through a range of mediums, e.g., sound, text and image, to democratise news production and mediation. As expected, although the CJNN project pilot supplied a mixed range of responses and inconclusive research findings, however it also supplied ample examples of potential improvements to the project for future iterations. Over the two-year-long duration of the project the research points towards one truly collaborative journalistic effort involving multiple citizen journalists in multiple hyperlocal environments. The story cluster that facilitated the mass collaboration was about an unusual weather event that affected the entire geographic area of Cornwall and impacted multiple individuals simultaneously. Therefore, it can be hypothesised that multiple levels of simultaneous impact upon participants facilitates and incentivises collaborative engagement. This hypothesis is evidenced within other common themes for collaboration within the app that also included popular activities such as travel, transport, the environment, history and heritage. Many of the remaining cluster themes such as domestic abuse, food poverty, industrial action and political campaigning can be considered a more highly niche or specialist interest for citizen journalists. It is anticipated that a significantly larger number of participants and a geographically wider dissemination and engagement programme could increase the amount of active collaboration and co-authorship as shared interests become more apparent within a larger study group.

8. Conclusion

The CJNN project is an example of DSI from the ground up in which individuals are included in the co-design and development of a local journalism platform. Such platforms provide the potential to support community efforts to produce a sense of place through sharing stories and images that reflect the lived realities of peoples' lives. However, there is a caveat to this interpretation. Unfolding in the EU is a real-time illustration of the fallacy of technological determinism, exemplified by the CAPS project amongst many. Technologies do not, in and of themselves, influence improvements in urban policy, health and wellbeing, prevent disease, protect the vulnerable or connect people together in meaningful pro-social ways. This is especially true when they bypass existing socio-technical infrastructure. The greatest fallacy is to assume that technology is, in and of itself, egalitarian. Indeed, there is a strong 'technologically enhanced' rhetoric running through social innovation policy (Walker, Esmene, Colebrooke, Leyshon, & Leyshon, 2020) that posits if only structural connectivity problems can be overcome then social ills can be solved. However, apps can just as easily create social anxiety, uncertainty, and atomise individuals. Hence, we must be careful not to rely on DSIs to simply replace the material social realities of individuals' lives through creating ever more 'virtual platforms' for dialogical purposes, because by doing so we will detach individuals from the subjective judgements and contributions they may be able to make to improve their urban environments. While we do not assume that DSIs will ameliorate all social problems, they can be an essential component in empowering and mobilising engaged individuals to create cities of digital innovation, in which practical actions maximise local resources to build progressive places.

DSI is often conceptualised as a social good with the potential to produce new and, by inference, better, 'state/organisation/individual' social partnerships that are delivered at a local level (Angelidou & Psaltoglou, 2017). Co-produced bespoke services are being designed and implemented through partnerships between service users and residents and a range of service providers. As illustrated in our CJNN example, DSI is positioned as an opportunity for individuals to influence fast policy responses via reporting change in their local neighbourhoods. DSI platforms like the CJNN are conceived as a "space of agency" from which social action can be mobilised, organised and delivered (Joseph & Skinner, 2012, p. 387). Success for such projects requires that individuals work outside their normal practices and beyond established organisational silos. As we discussed above, this is necessarily disruptive to business-as-usual and it generates a certain amount of productive anxiety that pushes individuals and communities to rethink their practices. The CJNN allowed individuals the freedom to innovate, to generate a space to foster social relations and produce new forms of social responsibility for local issues and environments.

Finally, this article represents a tentative step to move beyond the dichotomous perspectives of an uncritical technology-driven optimism of smart innovation as a universal panacea (Aitamurto, 2012) and the radical criticism and dissatisfaction with the 'wisdom' of the crowd (Lanier, 2006). By doing so, we contribute to debates on how DSIs help reconfigure notions of place by drawing individuals, hitherto distant from active placemaking, into the production processes of how places are made and remade through story telling. Our work also highlights the potential of how DSIs could challenge the way that knowledges are embedded in social institutions (Naess, 2013), forms of place-making (Tracey & Stott, 2017), reciprocal relationships and practices with a more 'organic' bottom-up approach to identifying the needs of local people (Harte et al., 2017). DSIs, like the CJNN, identify more imaginative ways of using existing resources and solving problems that have implications for society. In this regard it is no coincidence that DSIs have taken-off just as governments and cities have less scope for spending and are seeking to cut back on public finances. However, while some academics dismiss social innovation on this basis, arguing that it is a cover for a

state in retreat, we are advocating a less pre-committed approach to understanding these trends. It is important to explore the role of DSIs and assess their impact on a case-by-case basis. In so doing, there is a role for urban scholars to map out the emergence of this new form of social practice and the impact it is having without pre-judging its outcome.

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Conflict of Interests

The authors declare no conflict of interests.

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Article

Public Perception of Urban Air Quality Using Volunteered Geographic Information Services

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Abstract
Investigating perceived air quality (AQ) in urban areas is a rather new topic of interest. Papers presenting results from studies on perception of AQ have thus far focused on the individual characteristics leading to a certain AQ perception or have compared personal perception with on-site measurements. Here we present a novel approach, namely applying volunteered geographic information (VGI) technologies in urban AQ monitoring. We present two smartphone applications that have been developed and applied in two EU projects (FP7 CITI-SENSE and H2020 hackAIR) to obtain citizens' perception of AQ. We focus on observations reported through the smartphone apps for the greater Oslo area in Norway. In order to evaluate whether the reports on perceived AQ contain information about the actual spatial patterns of AQ, we carried out a comparison of the perception data against the output from the high-resolution urban AQ model EPISODE. The results indicate an association between modelled annual average pollutant concentrations and the provided perception reports. This demonstrates that the spatial patterns of perceived AQ are not entirely random but follow to some extent what would be expected due to proximity of emission sources and transport. This information shows that VGI about citizens' perception of AQ has the potential to identify areas with low environmental quality for urban development.

Keywords
air quality; CITI-SENSE; hackAIR; public perception; smartphone applications; volunteered geographic information

Issue
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1. Introduction

Investigating perceived air pollution in urban areas has caught the interest of researchers in the last two decades as the relationship between air pollution and adverse health effects has become clearer (Bickerstaff & Walker, 2001; Brody, Peck, & Highfield, 2004).

Despite significant improvements in air quality (AQ) in Western Europe, many European areas still struggle to reduce outdoor concentrations of particulate matter (PM) and nitrogen dioxide (NO_2; European Environmental Agency, 2018). The main local sources of air pollution in urban areas are road traffic, industry and domestic combustion (Gulia, Nagendra, Khare, &

Khanna, 2015). There is evidence that health effects such as strokes, heart diseases, acute and chronic respiratory diseases, including lung cancer and asthma, are linked to exposure to PM or NO_2 caused by air pollution (World Health Organization, 2016). The high number of premature deaths and years of life loss due to the effects of air pollution indicates the need for both further measures to reduce air pollution and to continuously raise public awareness and empower citizens to protect their health from the adverse effects of air pollution.

Evidence of adverse health effects of air pollution have not gone unnoticed by European citizens. In a recent Eurobarometer survey, 46% of the respondents indicated that air pollution is one of the most important environmental issues and 47% think that AQ has deteriorated in their country over the last 10 years (European Commission, 2017). This survey indicates that European citizens are aware of air pollution and perceive air pollution as a threat to health and well-being.

In the last decade, the application of volunteered geographic information (VGI) technologies in AQ monitoring has undergone a rapid development. In addition to for example exploiting VGI for applications such as emission estimates (López-Aparicio, Vogt, Schneider, Kahila-Tani, & Broberg, 2017), the application of VGI in the AQ field has seen substantial growth related to the emergence of low-cost AQ sensors. A large number of low-cost AQ monitoring sensor systems are now available on the market (Castell et al., 2017) which allow interested individuals to measure AQ instantaneously, providing information that can be used for private purposes or for the greater good (Castell et al., 2018), e.g., for creating AQ maps at high spatial resolution (Schneider et al., 2017, 2018; Wesseling et al., 2019). The rise of these measurement systems has facilitated measuring urban AQ at many different locations not covered by official monitoring stations. With the help of low-cost AQ monitoring sensor systems, lay people can perform measurements without the years of training needed to handle the technical equipment. Despite the fact that this technology is generally not yet mature enough to deliver data quality comparable to reference equipment (Liu, Schneider, Haugen, & Vogt, 2019) and still often requires a certain amount of data processing (Schneider et al., 2019), these instruments are still suitable to engage with citizens in AQ monitoring. They are instrumental for: (i) raising awareness about air pollution in the broader population (Sîrbu et al., 2015); (ii) educating and involving citizens in local communities (Turrini, Dörler, Richter, Heigl, & Bonn, 2018); (iii) bringing citizens closer together with policy and decision-makers (Turrini et al., 2018); and (iv) setting up larger networks of low-cost AQ monitoring sensor systems (Lisjak, Schade, & Kotsev, 2017; Wesseling et al., 2019).

Many projects and initiatives have been carried out in the last years, using low-cost technologies to monitor urban AQ (e.g., EU FP7 CITI-SENSE [Liu, Kobernus, Broday, & Bartonova, 2014], EU H2020 hackAIR [Kosmidis et al., 2018], H2020 iSCAPE [Mahajan et al., 2020], or Sensor.Community [https://sensor.community/en]). They mostly targeted collecting quantitative physical evidence of air pollution. We believe that qualitative information contributed by citizens can provide useful complementary knowledge. We also believe that to successfully address air pollution, physical data needs to be complemented by taking into account people's attitudes and perceptions. We have collected qualitative VGI information on AQ—reporting personal perception of the surrounding air through smartphone applications (apps).

To the authors' knowledge, there are two main categories of studies on perception of urban air pollution per today. The first category investigates individual characteristics that lead to a certain perception of air pollution (e.g., Mayer, O'Connor Shelley, Chiricos, & Gertz, 2017; Oltra & Sala, 2018). These studies investigate if perception of air pollution is influenced by factors such as risk beliefs, perceived threat or risks of air pollution, coping options and self-protective actions (Mayer et al., 2017; Oltra & Sala, 2018).

Studies in the second category compare AQ perception of volunteers with actual measurement results (e.g., Deguen, Padilla, Padilla, & Kihal-Talantikite, 2017; Pantavou, Lykoudis, & Psiloglou, 2017; Pantavou, Psiloglou, Lykoudis, Mavrakis, & Nikolopoulos, 2018). Some of those studies comprise of a quite complex study design, collecting, e.g., meteorological data, AQ data, information on the volunteers' age, gender and health status and their perception of the AQ at a specific geographic area over a specific time period. Some of the volunteers were even asked more specifically about their concern about AQ, level of support for certain AQ measures, or how informed they felt about certain measures (Schmitz et al., 2018). In another study additional individual characteristics such as family status, education level, occupation, housing area or commuting habits were put into relation with air pollution measurements (Deguen et al., 2017). In summary the results from both, the first and second category studies show that AQ perception depends on a broad range of internal and external factors and that ambient AQ is a multidimensional issue that influences people differently.

Here we introduce a novel third category, applying VGI technologies—i.e., smartphone apps-for reporting AQ perceptions. These activities have been carried out in the EU FP7 CITI-SENSE project (2012–2016) and the EU H2020 hackAIR project (2016–2018). Both projects engaged volunteers in AQ measurements in several places in Europe by reporting both sensor measurements and own perceptions of AQ. In this article, we look closer at the AQ perceptions reported by volunteers from the greater Oslo area in Norway and compare the perception data with data from reference AQ measurements and models. We discuss the results and conclude with recommendations of potential use of VGI methods for reporting AQ perceptions.

2. Study Area and Approach

Our study has its origin within the project CITI-SENSE (2012–2016). CITI-SENSE developed 'Citizens' Observatories' based on a collaborative concept with a focus on citizens' empowerment to influence their community policy in decision-making regarding AQ issues (Liu et al, 2014). As a part of the empowerment process, we aimed to raise awareness of AQ problems amongst citizens. We developed different tools, amongst them a smartphone app (CityAir app; see Figure 1, left), enabling people to indicate their perception of the surrounding AQ through a four-colour code. After downloading the app from Google Play or the App Store, the user could generate a user profile containing socio-demographic information (i.e., gender, age and education level). However, this information was not required in order to use the app. AQ perception could be reported by positioning a coloured marker on a map as provided by the smartphone's GPS location. The user could choose between four colours (green = 'very good,' yellow = 'good,' orange = 'poor,' red = 'very poor') to indicate how they perceived the AQ at their location. When choosing the colour yellow, orange or red, indicating that the perceived AQ was other than 'very good,' a second window would open where the user could select one or several of the perceived air pollution sources (i.e., traffic, industry, residential heating, port/harbour, dust, smoke, strong odour, pollen, others and 'I do not know'). The user could also leave a comment. The CityAir app also allowed the user to see what other users reported. Every time a user left a marker or a comment, the following information was stored locally on the phone and was later uploaded and stored to the cloud service we used in the project: colour of marker, GPS location, date, gender, age, education level (if available), perceived air pollution source(s) and any free-text comments. In case the user did not have Internet connection while reporting, the information was uploaded to the server as soon as the phone had Internet connection.

Public perception data was collected through the CityAir app between 1st September 2015 and 31st October 2016. Users were recruited from participants at the European Green Mobility week (N ≈ 150 people), a scientific breakfast event (N ≈ 70), leaflets in 21 public libraries in Oslo, distribution of leaflets to three schools and 17 kindergartens participating in other elements of the project, promotion of the app on Facebook, Twitter and web pages, information to volunteers who measured AQ (N ≈ 40), and through a dedicated four-day social media campaign in collaboration with research partners and a patient organization.

A similar app was used within the EU H2020 hackAIR project, an open technology platform for anyone to access, collect and improve AQ information in Europe. The main aim of the hackAIR project was to raise public awareness about the problem of air pollution and at the same time as motivating citizens to monitor outdoor AQ on their own (Kosmidis et al., 2018). This could be done through building their own low-cost AQ sensors, taking a picture of the sky (Spyromitros-Xioufis et al., 2018) or reporting subjective perceptions of the surrounding AQ. The option of reporting personal AQ perception was part of the hackAIR smartphone app (Figure 1, right). In order to submit AQ perceptions, the user had to go to the 'perception of AQ' tab at the smartphone app,

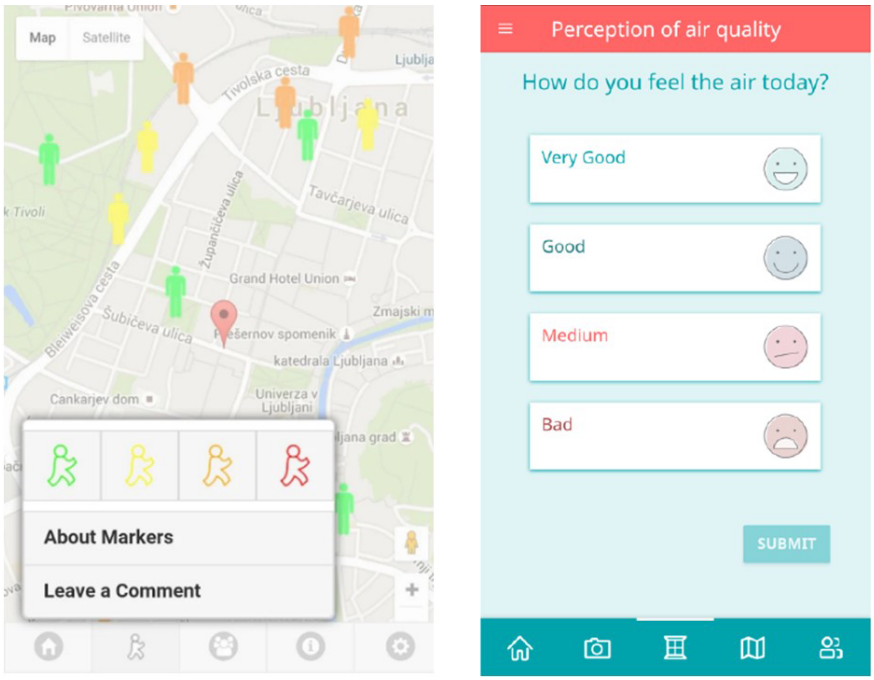

Figure 1. From left to right: Screenshot of the CityAir app and the functionality to report personal perception in the hackAIR app.

turn on GPS location and choose one of four categories: 'very good,' 'good,' 'medium' or 'bad.' By choosing one of these categories and clicking the 'submit' button, the perception was automatically logged and appeared on the map at the position provided by the smartphone's GPS. The anonymised observation could be seen by other hackAIR users on a map.

AQ perception has been reported through the hackAIR app between 9 February 2018 and 8 February 2019. Participants were recruited during 'build-your-own-AQ-sensor' workshops (115 persons) and through social media campaigns (Facebook event and Facebook video).

Both CityAir and hackAIR smartphone apps were developed for Android and iPhone and were made available through Google Play and App Store where they are still available for download today.

In this article, we address the perceptions of volunteers in the greater Oslo area in Norway, obtained from the CITI-SENSE and hackAIR projects. For the greater Oslo area, we have access to high-resolution (100 × 100 m) output from the state-of-the-art urban-scale air pollution dispersion model EPISODE (Hamer et al., 2019), and we are able to match the obtained VGI data with the model results using the GPS position. Using the EPISODE model allows us to obtain AQ information at any spatial location in the city. Comparing the collected data with observations from AQ monitoring stations would limit the comparison substantially because the comparison could only be carried out in the immediate vicinity of the station, thus eliminating the vast majority of perception samples from further analysis. We use this data to perform a basic comparison of the qualitative perceptions against annual average estimated air pollution in order to investigate to what extent the spatial patterns of subjective perceptions align with modelled AQ estimates. More specifically, we have extracted the annual average modelled concentration value for each of the three main pollutants (NO_2, $PM_{2.5}$, and PM_{10}) at each location where perceptions were reported. The actual annual average is obtained as a bilinear interpolation between the neighbouring four grid cells at 100 × 100 m resolution. We then plotted and summarised the values for each perception class.

3. Statistical Analysis

In this article, we present the results of two data collection studies, the first using the CityAir app and the second using the hackAIR app. The classification of pollution levels consists of four classes in both apps, though the hackAIR app uses 'medium' where CityAir uses 'poor' and 'bad' where CityAir uses 'very poor.' Other differences are that the CityAir app allows the user to register (i) demographics information and (ii) which source of pollution they think contributes to reduced AQ.

Sampling periods in this article are for CityAir, September 2015–October 2016, and for hackAIR, February 2018–February 2019.

On the basis of the CityAir app data, we would like to establish if the perceptions reported through the app differ based on gender, age and education level, using a contingency table approach; this is to ascertain if the subsequent analysis of association between the perception and AQ needs to be controlled for these factors.

For both sampling periods, we assigned to each perception registration the annual average pollution level corresponding to the year of the registration. This average was calculated by the EPISODE model.

For both studies, we investigate whether the perception reported through the apps correlates with a long-term average air pollution model. We have limited our work to an analysis of variance of a hypothesis 'does the air pollution differ between perception classes' for each air pollutant separately, using pairwise Wilcoxon Rank Sum tests. We then tested the null-hypothesis that average pollution levels are the same for all perception classes.

4. Results

4.1. CityAir App

4.1.1. Demographics

332 reports were available for analysis. However, we used the parameters 'male,' '1970,' and 'high school' as demographic standard settings that people could but did not have to change, and 'traffic' as a pre-set pollution source, that could be changed. For demographic analysis, we had to de-validate cases recording only the three pre-selected categories to make sure only valid cases remained. Thus, we had 241 valid reports for age, gender and education level that could be used for the socio-demographic description of the population involved.

The CityAir app users were 55% male and 45% female. The app was more commonly used by younger people: 65% of users were born between 1970 and 1989. About one third of the participants were born before 1970, more than 60% between 1970 and 1990. Participants were rather well-educated: 62% of the participants held a university degree and 28% a PhD; only 10% of the participants have not completed university (Figure 2).

In our sample, we had more younger men (born 1970–1989) than women and more older women (born 1960–1969) than men. More men than women reported high school and university as highest level of education, whereas more women than men held a PhD degree (Figure 3).

A contingency table analysis (perception vs education, perception vs gender, perception vs decade of birth) did not reveal any significant differences (Table 1).

4.1.2. AQ Perception

Since there do not seem to be any statistically significant differences in reporting based on education level, gen-

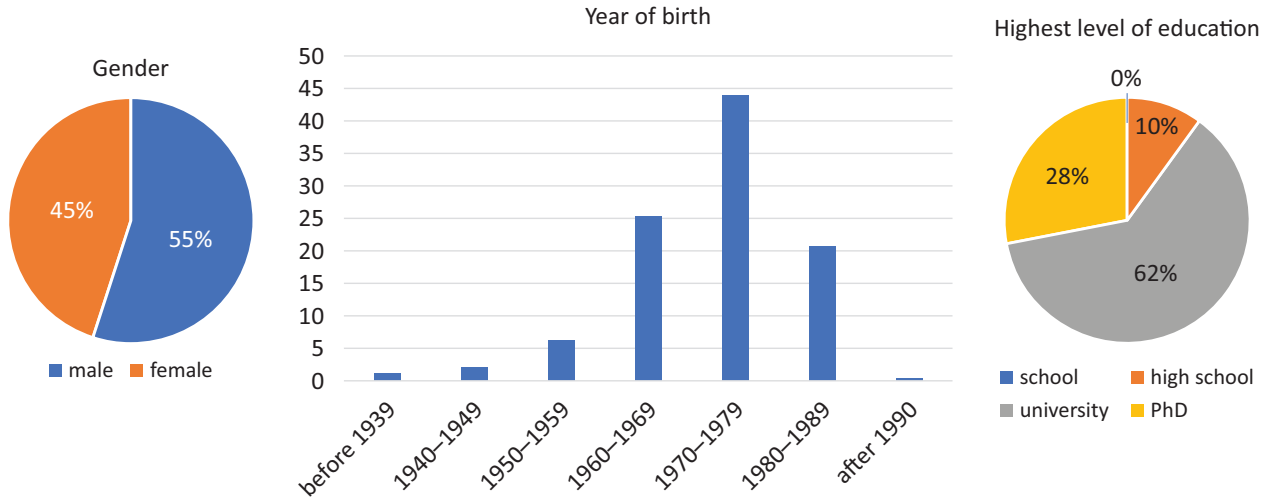

Figure 2. Characteristics of the CityAir users (in %).

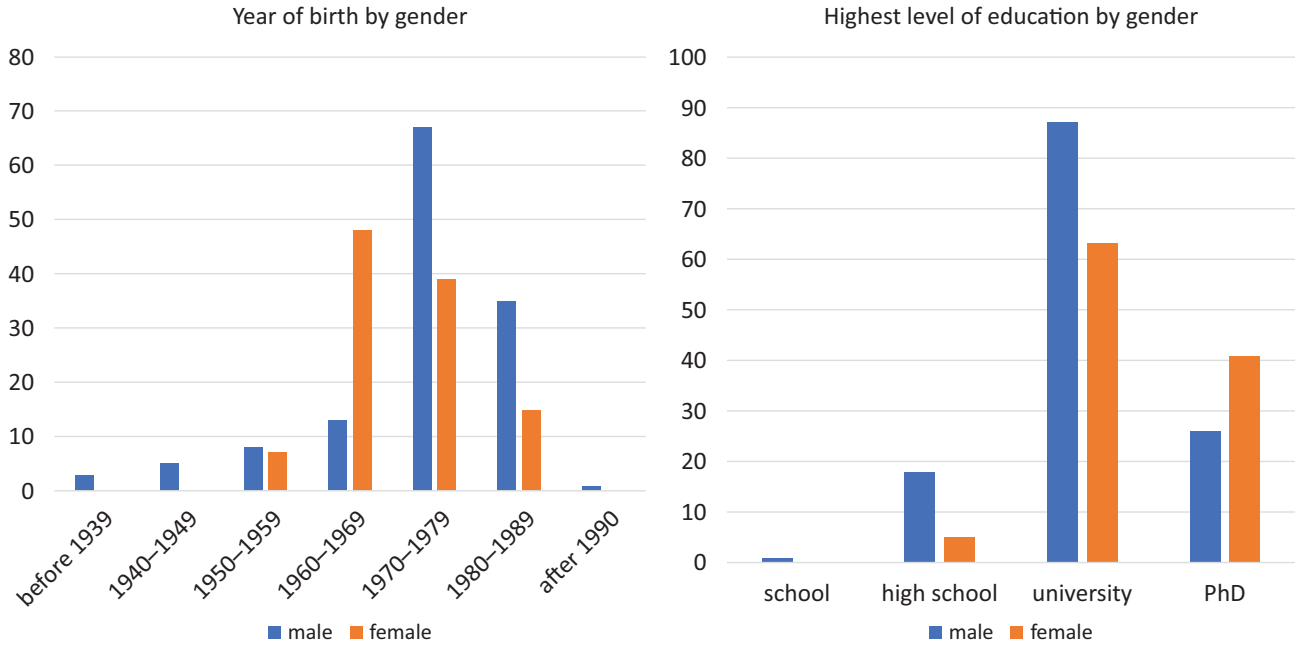

Figure 3. From left to right: Distribution of age and gender and distribution of education level and gender of the CityAir app users.

Table 1. Distribution of perception reporting, by age, gender, and education level (N = 241).

	Year of birth				Gender		Education level		
Perception	Before 1960	1961–1970	1971–1980	1981 and later	Male	Female	School and high school	University	PhD
Very good	16	28	50	28	70	52	10	77	35
Good	4	20	23	12	26	33	6	40	13
Poor	1	5	21	7	21	13	5	18	11
Very poor	2	8	12	4	15	11	2	16	8

Note: Test by chi-square revealed statistics values chi-square = 11.28 (9 d.f.) for relation with age category, 4.03 (6 d.f.) with education and 3.83 (3 d.f.), all of them not significantly different from zero (p = 0,05).

der or age, we used all 332 reports for the analysis relating perception to AQ. 75% of the participants assessed the greater Oslo area AQ as 'good' (52% 'very good,' 23% 'good'), only 21% reported 'poor' AQ in Oslo (13% 'poor,' 8% 'very poor'; see Figure 4).

We obtained more perception data in autumn 2015, due to the first recruitment activities. A bad AQ episode in February 2016 resulted in more frequent use of the CityAir app. We intensified our recruitment activities in April, followed by a Facebook event in May, which led to a higher number in reports, and a newspaper article on the project was published in September.

4.1.3. Perceived Air Pollution Sources

Users could also indicate what pollution source(s) they thought contributed to the bad AQ. Multiple answers were possible. In first place was 'traffic' with 115 reports, followed by 'dust' with 41 reports. The remaining categories were named less than 20 times, with 'port/harbour' in last place with only two reports (Figure 5). However, note that 'traffic' was a pre-set pollution source, that people could—but did not have to—change. Thus, it cannot be ruled out that the high number of 'traffic' reports could be caused by people who did not change the pre-set pollution source.

4.2. hackAIR App

The hackAIR dataset consisted of 204 reports. 55% of the volunteers reported Oslo AQ as 'very good' (N = 112) and 32% as 'good' (N = 66). The designation 'medium' was assigned to the Oslo air by a total number of 25 volunteers (12%) and only one volunteer equalling 0% reported the class 'bad' (Figure 6). It was not required to provide information on gender, age or education when

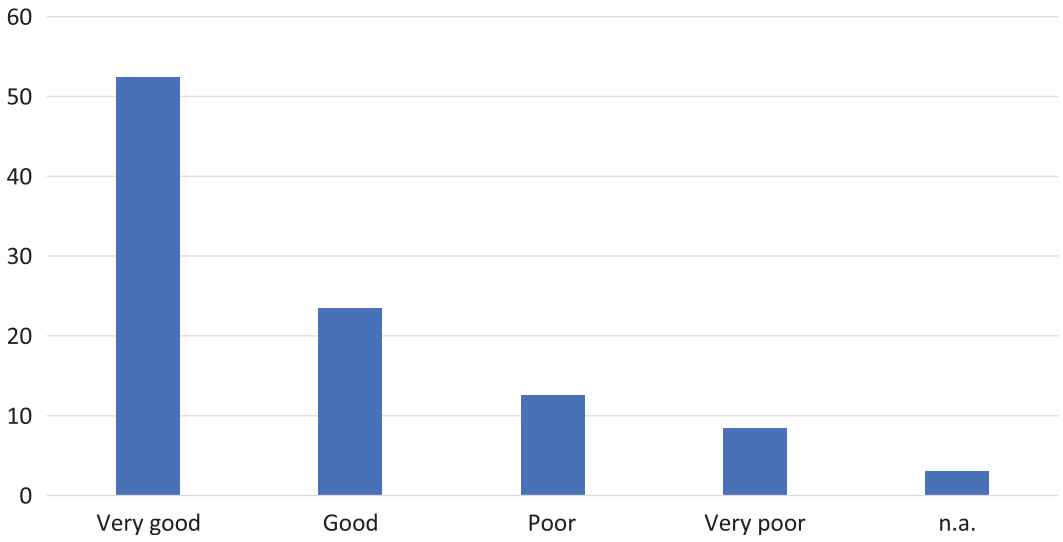

Figure 4. AQ perception of the CityAir app users (in %).

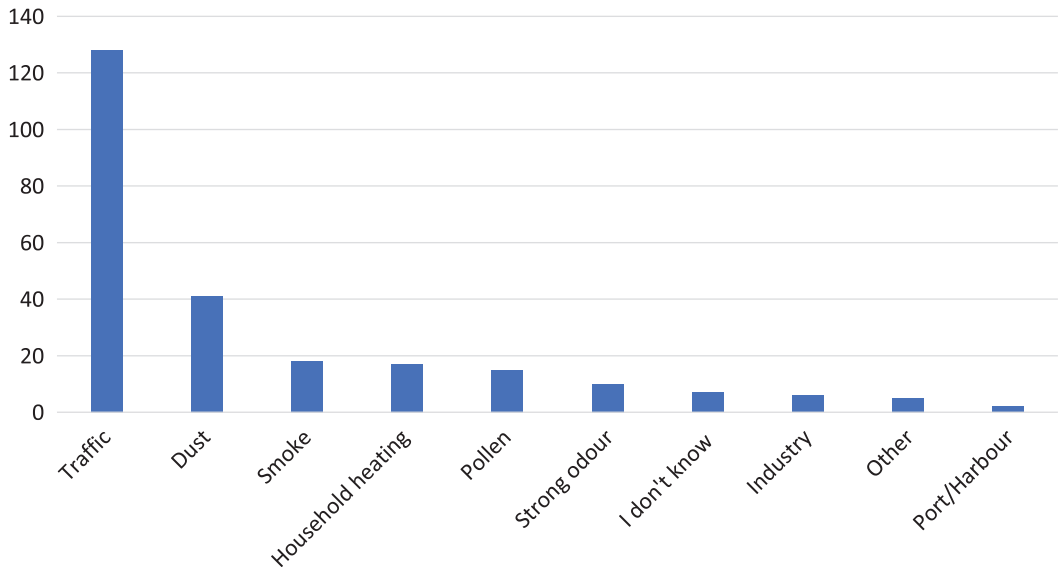

Figure 5. Pollution sources indicated by the CityAir app users.

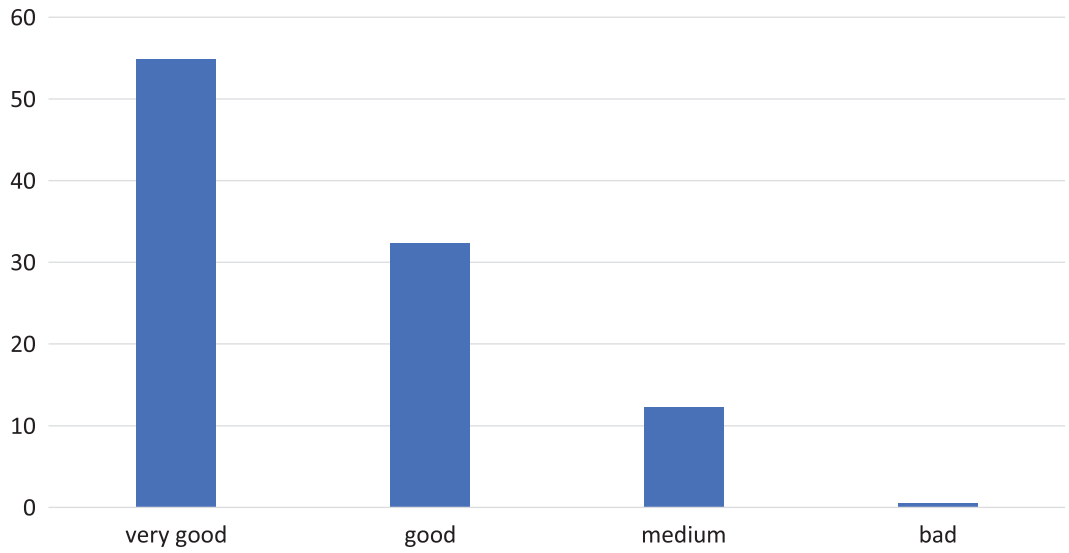

Figure 6. AQ perception of the hackAIR app users (in %).

logging on to the hackAIR app. Users could also choose not to indicate any pollution sources.

The official hackAIR-launch took place in February 2018, followed by a number of local workshops in March/April and June 2018, where people could build their own AQ sensors. At these events, we also promoted the use of the hackAIR app to report AQ perceptions. Both occasions resulted in a higher number of reported AQ perceptions. We arranged a Facebook event in June 2018 to promote the use of the hackAIR app. This led to a higher number of observations. In autumn that year, we arranged another round of workshops, followed by a Facebook video to promote the use of the app for reporting personal AQ perceptions. This resulted again in a higher number of perceptions reported through the hackAIR app.

4.3. Comparison with AQ Estimated by the EPISODE Dispersion Model

To evaluate whether the reports on perceived AQ from the perception datasets contain information about the actual spatial patterns of AQ, we carried out a comparison of the perception data against the output from the high-resolution urban AQ model EPISODE (Hamer et al., 2019). This complex model has been verified to represent the AQ well both in time and space and it provides point estimates with spatial resolution of down to five meters. The results indicate a relationship between the average modelled pollutant concentrations and the provided perception reports, thus indicating that the spatial patterns of perceived AQ are not entirely random but follow to some extent spatial patterns of AQ.

Figure 7 shows modelled annual average concentration fields of NO_2, PM_{10} and $PM_{2.5}$ for the greater Oslo area and also indicates the location of the perception reports from both the CITI-SENSE and the hackAIR project. While the vast majority of perception reports was located within the city of Oslo (hotspot slightly north from the map centre), some reports were also received from less densely populated areas outside the city limits.

Figure 8 shows how the average modelled AQ for the three pollutants varies with the four perception classes for the CityAir dataset (N = 332; above) and for the hackAIR dataset (N = 204; below).

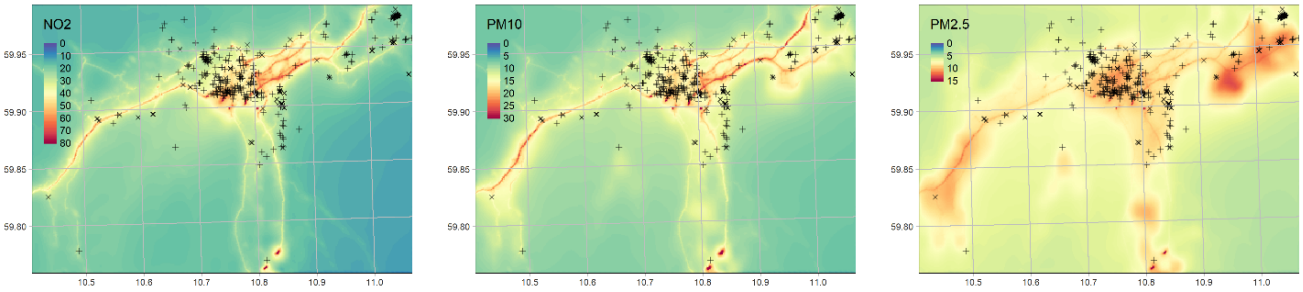

Figure 7. Long-term average concentrations in units of µg/m^3 for the greater Oslo area as provided by the EPISODE model (Hamer et al., 2019). Notes: The pollutants NO_2, PM_{10}, and $PM_{2.5}$ are shown in the left, centre, and right panel, respectively. Locations of the perception reports are marked as + for CityAir and as x for hackAIR. Axes units are degrees latitude and longitude (WGS84).

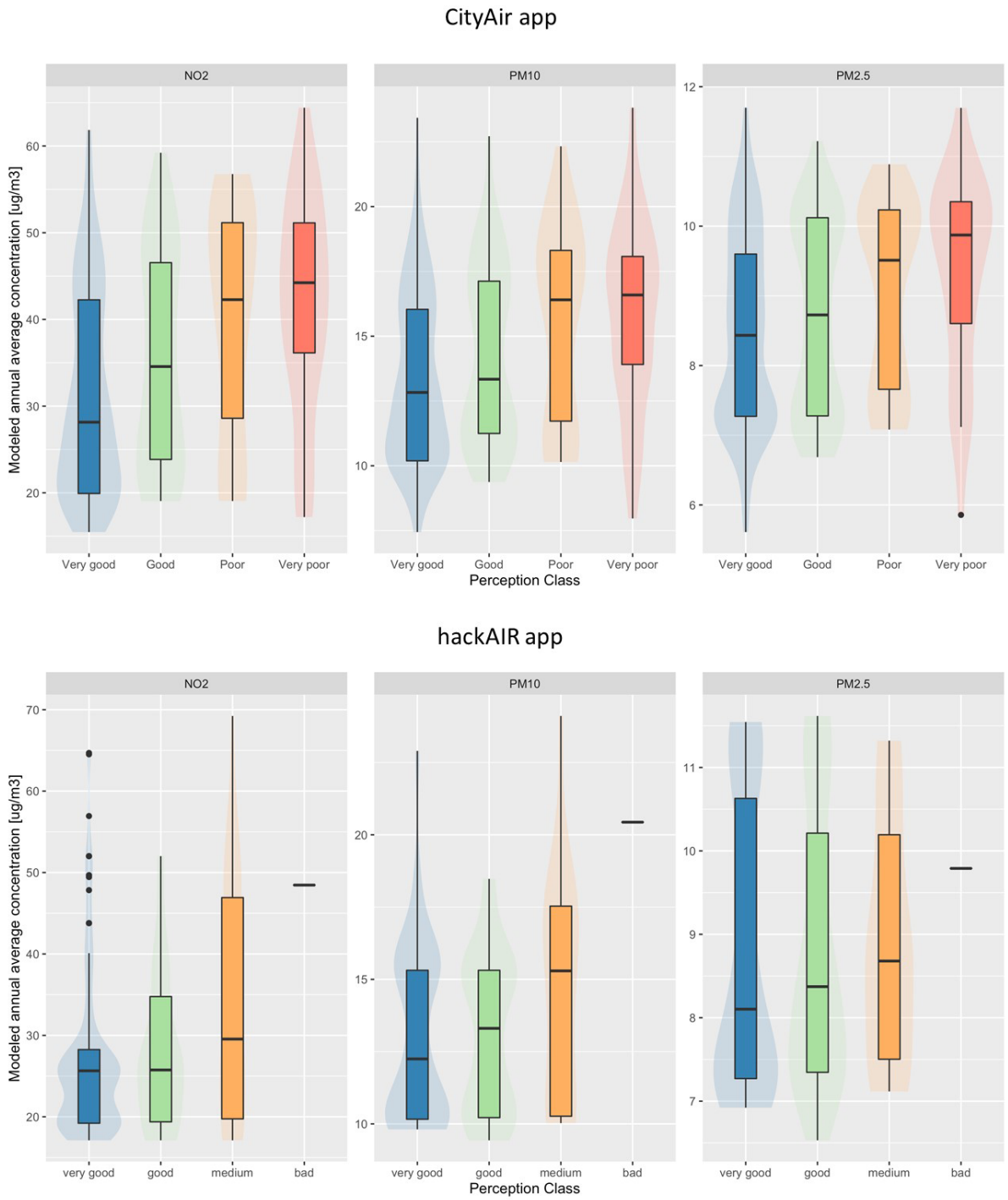

Figure 8. Combined Box- and Violin-plot showing the modelled annual average concentration for NO_2, PM_{10}, and $PM_{2.5}$, respectively, extracted at the location of the four perception classes used in the CityAir app (above) and the hackAIR app (below). Notes: The slightly transparent areas in the background of the boxplots show the actual underlying distributions. The lower and upper hinges of the boxplots correspond to the 25th and 75th percentiles, whereas the whiskers extend to 1.5 times the interquartile range with any data beyond the whiskers (outliers) plotted individually.

For CityAir, we can observe in all three cases that the median modelled pollution level systematically increases from the 'very good' to the 'very poor' perception class. While there is significant overlap between the individual classes, this shows that on average the reports on perceived AQ match the expected spatial patterns.

For the hackAIR data, not all perception classes are populated with enough samples to calculate the appropriate summary statistics (i.e., the 'bad' class only contains three values) and the computed differences are less significant and prone to higher uncertainties. However, the general pattern of increasing modelled concentra-

tion levels with perception classes going from 'very good' to 'bad' prevails. One exception can be seen for NO_2 where the 'excellent' class has approximately the same median as the 'good' class. This is quite likely a result of the comparatively low number of samples. It is expected that with an increasing number of perception reports, the figure for hackAIR would begin to resemble more clearly the patterns seen in the figure for CityAir (Figure 8).

Table 2 shows the adjusted p-values for pairwise Wilcoxon Rank Sum tests and thus gives some indication on which of the differences in class medians shown in Figure 8 are statistically significant. For the CityAir app the 'very good' class is different from nearly all other classes (except for the 'good' class of PM_{10} and $PM_{2.5}$). The other classes are not statistically significant against each other. For the hackAIR app it is only the 'medium' class for NO_2 that is statistically significant from the 'very good' class.

5. Discussion

Our results indicate that the perception data have the potential to indicate local AQ, in our case measured as an annual average for three pollutants. In urban areas, the most prominent sources of air pollution are local traffic and residential heating. Traffic in particular is likely to contribute to other stressors such as noise, and areas with high traffic load are also likely to lack qualities such as green spaces.

The pilot studies in both the CITI-SENSE and the hackAIR project have not been designed to demonstrate whether or to which degree citizens-as-sensors/VGI can produce useful AQ data. The main purpose was to engage with citizens, raise awareness about AQ and to provide them with a tool to report their own AQ perceptions.

In this article, we look closer at the AQ perceptions reported through VGI tools in the greater Oslo area, and try to understand if there are any patterns that are not related to AQ. We observed that both CityAir and hackAIR participants judged the AQ in the greater Oslo area as good. It would be interesting to explore in more detail the motivations for the answers given, but the information obtained through the two apps allows this only to a limited degree. Perception is a complex and dynamic process that differs between individuals. It is influenced by a wide variety of internal and external factors (Bickerstaff & Walker, 2001). Several studies have found a positive correlation between age, gender, education and socio-economic background to AQ perception (Bickerstaff & Walker, 2001; Brody et al., 2004; Deguen et al., 2017; Forsberg, Stjernberg, & Wall, 1997; Howel, Moffatt, Prince, Bush, & Dunn, 2002; Pantavou et al., 2017; Schmitz et al., 2018). Studies by Piro, Madsen, Næss, Nafstad, and Claussen (2008) on the other hand showed that there was no significant relationship between the perception of AQ and factors such as age, education, and gender. For the CityAir users, we cannot confirm significant dependencies of perception on gender or education level. The difference between perception in different age classes is rather weak, possibly due to the low number of observations for some classes. Additional determinants for perception, such as health (i.e., people with poorer health often report AQ to be worse than those with better health; see Howel, Moffatt, Bush, Dunn, & Prince, 2003; Orru, Nordin, Harzia, & Orru, 2018; Schmitz et al., 2018) or general concern about the environment and AQ in particular (studies show that people that are generally concerned about AQ seem to perceive AQ as worse than it actually is, even though objective AQ monitoring data shows that the AQ has improved; see Mally, 2016; Oltra & Sala, 2018; Schmitz et al., 2018), cannot be explored due to missing information about these factors.

AQ perception can also be shaped by the area of residence, source of pollution and thermal sensation (Huang, Rao, van der Kuijp, Bi, & Liu, 2017; Pantavou et al., 2017). In general, people more likely perceive air pollution when they can see dust, hear traffic and see exhaust fumes, rather than when it cannot be sensed through visual and sensory feedback (Gatersleben & Uzzell, 2000;

Table 2. p-value matrices of non-parametric pairwise Wilcoxon Rank Sum tests for the data shown in Figure 9.

	CityAir				hackAIR			
		Very good	Good	Poor		Excellent	Good	Medium
NO_2	Good	**0.0257**	—	—	Good	0.3356	—	—
	Poor	**0.0010**	0.0934	—	Medium	**0.0477**	0.1717	—
	Very poor	**0.0010**	0.0617	0.7326	Bad	0.2199	0.2199	0.4232
PM_{10}	Good	0.0744	—	—	Good	0.8797	—	—
	Poor	**0.0027**	0.1166	—	Medium	0.1618	0.1618	—
	Very poor	**0.0027**	0.0744	0.8152	Bad	0.1618	0.1618	0.1705
$PM_{2.5}$	Good	0.4178	—	—	Good	0.6065	—	—
	Poor	**0.0378**	0.1762	—	Medium	0.6065	0.6065	—
	Very poor	**0.0283**	0.0851	0.4323	Bad	0.6065	0.6065	0.6065

Notes: Difference between class medians that are statistically significant at the 0.95 level are marked in bold. The p-values were adjusted for multiple comparisons using the Benjamini and Hochberg (1995) method.

Pantavou et al., 2018). For the CityAir app, we found indications that the physical experience of air pollution in spring (i.e., road dust, salt and gravel from the winter) could have led to a higher reporting rate of worse AQ perception.

The fact that the overall judgement of AQ in the greater Oslo area was rather positive could also be attributed to the so called 'Halo Effect.' This phenomenon describes the tendency of people who live in a polluted area to neglect the risks of air pollution in those areas where they live and work (Brody et al., 2004). The reluctance of people living in urban areas to recognise poor AQ in their local environment shows that people's perception is not only dependent on technical risks, but also on factors such as trust (e.g., towards governments and regulatory institutions), political or economic empowerment and democratic processes, cultural factors and worldviews (Bickerstaff, 2004; Bickerstaff & Walker, 2001).

Another potential reason for a bias in perceived AQ compared to AQ measurements could be related to media activities. Media has the potential to influence people's perception of risks, not necessarily through creating opinions about risks or shaping risk perception, but rather through shaping 'the societal experience with risk' (Cologna, Bark, & Paavola, 2017; Renn, 2008). Thus, media's intention and the way stories are told can be quite influential for people's risk perception (Sharp, Jaccard, & Keith, 2009). The influence of the media in the usage of the CityAir and the hackAIR app is demonstrated by increased reporting activities during social media events and after publication of newspaper articles.

However, without any additional information at hand, it is impossible to draw conclusions about the motivation or factors leading to the submission of a particular perception marker for both the CityAir and the hackAIR app.

The second focus of this article is to compare the perception data obtained through the two smartphone apps with objective data on AQ. We carried out a comparison of the perceived AQ data against the output from a high-resolution urban AQ model EPISODE (Hamer et al., 2019). The results indicated a positive association between the average modelled pollutant concentrations and the perception reports. The CityAir app data showed a statistically stronger correlation with the AQ model than the ones from the hackAIR app. This can to some extent be related to the number of observations—the volume of the data from the hackAIR app is only two thirds of those from the CityAir app, thus, the relationship is weaker.

Our results indicate that the use of VGI for reporting of personal perception may prove to be of value in different respects. It could facilitate collection of a large amount of location specific data from people across different backgrounds and is not only limited to AQ or other kinds of environmental monitoring. This offers the potential to provide researchers with large data sets on indications of environmental quality in places not directly covered by monitoring. Our results indicate that the perception is associated with actual pollution levels, and this again provides higher credibility for data collected for new hotspots.

Mobile apps like CityAir or hackAIR are low-threshold tools that enable collection of large volumes of environmental information from the public. The use of VGI through apps such as CityAir or hackAIR could provide citizens with tools for democratisation. However, several issues need to be solved for the apps to be useful in practice, not least the recruitment of users. Despite the efforts to recruit, we have only recruited a very small percentage of the Oslo population. Willingness to engage with this kind of information sharing can be subject to the same underlying factors as the individual perception and would have to be further considered in a large-scale reporting experiment.

Tools like the CityAir and the hackAIR app may be suitable to support urban planning processes, providing citizens with a voice about their own perception and experiences for their neighbourhood or city. Citizens' involvement using VGI approaches in urban planning is already happening (e.g., Maptionnaire [Kahila & Broberg, 2017]), although not on a large scale. Many tools exist for participatory urban planning, e.g., the use of the public participation GIS (PPGIS) in urban planning (Bugs, 2012), Urban Geo-Wiki for improving urban land cover (See et al., 2013), the Urban Analysis Kit for crowd-creative urban design (Mueller, Lu, Chirkin, Klein, & Schmitt, 2018), and the ChangeExplorer for generating citizen involvement in local planning processes (Wilson, Tewdwr-Jones, & Comber, 2019). It seems that PPGIS has the transformative power to empower citizens to voice their different opinions. However, challenges such as effective engagement, recruitment of a broad spectrum of people and co-production of high-quality knowledge exchanges with actual effects on urban policy making still remain an issue (Brown & Kytta, 2014). Since apps like CityAir and hackAIR do not have the capacity to resolve these challenges, they still could be used as a 'light' complement for tools that do not include any other VGI approaches. This would strengthen citizens' voices and contacts between urban planners, decision-makers and citizens.

We observed that reports on perceived AQ indicate a relationship between average modelled pollutant concentrations in Oslo and the perception data. Thus, the application of VGI approaches to learn about citizens' perception of AQ should be used further in urban development to promote participation, transparency and credibility. Nevertheless, it has to be ensured that uptake by authorities is actually happening and that the citizens participating in the VGI reporting also receive feedback about the results and the uptake of their data.

6. Conclusion

The CityAir and hackAIR apps were designed to get feedback on perceived AQ over a longer time period and at different geographic locations within the larger Oslo area.

The apps were not intended to investigate the motives behind urban AQ perception ratings, but to provide citizens with a voice. AQ in Oslo is most of the time below the limit values for the three pollutants studied here. The majority of the people that used the CityAir and hackAIR app perceived the AQ in the greater Oslo area as good. Where they perceived AQ as worse, the reference measurements often showed values below the limit values for the three major air pollutants (NO_2, PM_{10}, $PM_{2.5}$). However, overall, the classes of perceived AQ showed associations with long-term average estimates. This indicates that the spatial patterns of perceived AQ match those estimated on the basis of dispersion processes. Modelling is currently the only way to provide AQ data with high spatial granularity. It is likely that perceived AQ also matches the typical temporal patterns of AQ (e.g., diurnal, weekly and seasonal cycles), however due to the relatively low number of reports available, we could not evaluate this within this study.

Environmental decision making including urban development should be a participatory process, embedding also people's perception of the environment and giving them the opportunity to express both positive views and concerns. Urban planning will certainly benefit from including public perception research as a tool to better understand socio-cultural dimensions and the beliefs and emotions that shape risk perception. The application of VGI approaches will allow citizen engagement and provide information on how people feel about their urban environment. This approach will provide more participation, transparency and credibility in urban planning processes and has a potential that should be investigated further.

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Conflict of Interests

The authors declare no conflict of interest.

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Article

Digital Social Innovation and the Adoption of #PlanTech: The Case of Coventry City Council

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Abstract
The smart city trend has generated considerable interest in using digital technology to transform urban planning and governance, and in the UK the government funded Connected Places Catapult has been given the remit of stimulating innovation in cities. One of its focuses is urban planning and technology (#PlanTech) which has garnered attention from the Royal Town Planning Institute, a vast number of the UK local authorities, academia and technology companies. #PlanTech aims to revolutionise the urban planning industry across public, private and not for profit sectors in an era where fiscal austerity has catalysed a drive for using advanced technologies to improve the efficiency of operations and decision making. Technological innovation is being promoted to enable local authorities to deliver services with significantly reduced financial resources while simultaneously creating a modernised and more efficient public sector. Within this context, this article uses a detailed ethnographic study of planning functions in Coventry City Council, UK, to analyse how they have adapted so far in response to both austerity and the drive for digital innovation. The article concludes by examining how #PlanTech and digital social innovation may help deliver the broader smart city strategy.

Keywords
Coventry; digital social innovation; governance; planning technology; smart cities; UK

Issue
This article is part of the issue "The City of Digital Social Innovators" edited by Chiara Certomà (Ghent University, Belgium), Antonella Passani (T6-Ecosystems, Italy) and Mark Dyer (University of Waikato, New Zealand).

1. Introduction

Urban planning has transitioned through various paradigms since its inception as a profession in the UK. The Royal Town Planning Institute, the UK's professional planning authority, was founded in 1914 to set professional standards, conduct and fund research, and progress the discipline. Since 1914 various theoretical frameworks have been adopted by the profession to improve the delivery of planning outcomes for stakeholders. These include 'systems and rational' planning of the 1960s which sought to introduce computational and model based approaches to solving urban problems, and more recently, 'collaborative planning' which attempts to create an open and democratic approach to delivering solutions that accommodate the needs of all stakeholders and is the basis for contemporary planning practice in the UK (Connell, 2010). Urban planning within the UK has received criticism for being archaic, burdensome and in need of an overhaul to improve its effectiveness, accessibility and impact (Airey & Doughty, 2020). Now at the dawn of the information economy, technology is increasingly proposed as the solution.

The advent of smart cities has seen a revival of interest in using technology to create urban spaces that can be observed, managed and developed through a distributed network of sensors and widespread data collection/analysis (Kitchin, Lauriault, & McArdle, 2015; Townsend, 2015). Led by multinational technology companies, an ecosystem has evolved in the UK to produce technology for cities, specifically in the fields of property, construction and planning.

Definitions of a smart city have evolved and changed to incorporate different components of the urban system while retaining a fundamental basis of ICT. Mosannenzadeh and Vettorato (2014, p.685) write:

> Reviewing the literature shows that the concept of smart city has been developed in three main areas: (i) academic, (ii) industrial, (iii) governmental. Reviewing these literature shows two important points: First, the meaning of smart city is not settled yet; however, there is an agreement on the significant role of ICTs in smart urban development. A simple keyword analysis of existing literature shows the disparity of words used in different definitions which is a sign of controversy in the concept.

The complexity of urban environments means that defining 'smart' operating standards and the associated components is a challenging task that inevitably differs between cities. The foundation of the smart city is a physical infrastructure based on sensor networks embedded across the urban environment which is connected through wireless Internet and interacts with other devices, such as mobile phones and servers, where data is stored, analysed and fed back into the system. Information such as road conditions, location and condition of city assets, and structural information about physical infrastructure can be used for monitoring and proactive management (Cassandras, 2016).

The adjective smart implies the concept of technological innovation (Rosati & Conti, 2016) yet neglects the existing pillars of urban governance. Not only do the ICT chains make economic value, but they also exert social and spatial influences (Florida, 2002; Graham & Marvin, 1996). This implicit bias toward technology has raised concerns about the effectiveness of widespread ICT systems in the democratic governance of cities, of which urban planning is a core function. As a key urban development objective for many cities, the smart city is intrinsically an urban planning issue.

Digital transformation is a key priority for the British Government and has been a central feature of many policies and strategies. For example, the 'industrial strategy' (HM Government, 2019) provides the industrial development goals and mechanisms for delivery. Infrastructure, places, innovation and technical education are among the targets, along with ambition to develop an artificial intelligence (AI) and data economy. To facilitate the development of this data driven economy the government will establish an office for AI that works to deliver efficiencies and digital best practices to the wider public sector. In 2017 the government published it *Government Transformation Strategy* to outline the future provision of public services and administration. Outlining the need to become more adaptive and innovative, the policy recommends transforming the public sector "by harnessing digital to build and deliver public services" (HM Government, 2017).

The Connected Places Catapult (CPC) was established in 2019 (its predecessor Future Cities Catapult was founded in 2011) by the British Government as part of the Innovate UK initiative to foster research and development into emerging industrial opportunities. The CPCs remit is to "work across boundaries and bureaucracies, bringing demand and supply sides together to unlock new markets and drive growth within complex systems" (Cpcatapult, 2020). Within this, the future cities division is focused on fostering innovation in city related professions by developing new technology-based processes and solutions for challenges faced in these industries. The planning technology team within the future cities division (#PlanTech) has the portfolio relating to innovation in urban planning.

Dinant, Floch, Vilarinho, and Oliveira (2017, p.1) define digital social innovation as a "novel solution to a social problem," it is a delivery mechanism that uses technology to address social needs (Anania & Passani, 2014). It is:

> Organised as a public–private partnership based on an active role of citizens and the use of state-of-the-art information technology to engage citizens, to support stronger links (data exchange, visualization) and thus to multiply the potential effect of grass-root initiatives. (Anania & Passani, 2014, p. 1)

Supported by the European Union, digital social innovators are key to advancing the EU's digital agenda.

Research into the role and impact of technology use in planning is not new. Harris (1989) wrote:

> The virtue of using computers in planning, and the importance of geographic information systems (GIS) are ideas in common currency that appear everywhere in the planning literature. They influence the organisation of professional meetings, and increasingly help determine the organisation and staffing of planning offices and through this the shape of planning education. (p. 1)

Thus, the use of technology and Planning Support Systems in particular has had implications for both planning practice and urban governance. As the role of technologies grew, how a planner performed their job and indeed the methods used to produce plans changed. Shiode (2000, p. 110) noted that "computers have assisted urban planning and urban management for over three decades" and planning practice has evolved to integrate these systems.

Digital technology has never been more pervasive in business and society. The rapid growth of the Internet, the ubiquitous use of smartphones and portable devices, and the growing digital economy has generated a mass of real time data, much of which has geographical attributes such as co-ordinates. This infrastructure and the data produced are key opportunities for #PlanTech which has 5 broad imperatives: automation, machine learning, public participation GIS, city information modelling and virtual/augmented realities (Thompson, Greenhalgh, Muldoon-Smith, Charlton, & Dolnik, 2016). Much of the ecosystem that currently exists in the UK is working

on solutions that operate on these themes and aims to produce digital systems that can improve delivery of planning in local authorities. Much of this innovation emulates the computer-based planning tools developed in the 1960s and 1970s such as "early generations of Geographical Information Systems (GIS) and Decision Support Systems, used for data management, modelling and strategic planning support" (Geertman & Stillwell, 2003, p. 4). This broad suite of tools developed with the aim to aid in the practice and delivery of urban planning fall under the umbrella term of 'Planning Support Systems.'

Urban planning digital transformation offers an exciting opportunity for digital social innovation to maximize its social, economic and environmental impact. Similarities exist between the broad objectives of these activities which signals their potential complementarity. For example, urban planning's role to mediate between the social, economic and environmental (Campbell, 1996) dimensions of urban development in order to deliver urban spaces that function in the public interest, and digital social innovations objective of using technology to deliver solutions to social needs (Dinant et al., 2017), create an opportunity to use technological innovation and deliver on mutual goals.

In the UK Open Systems Lab is a key organisation working at the cross-roads of digital social innovation and planning/construction. Open Systems Lab describes their products as "common platforms that allow any citizen or business to collaborate and compete in society or the economy, usually for free and always without asking permission" (Open Systems Lab, 2020). The organisations ethos is to maximize the citizen sector in digital innovation and "to build a successful, sustainable, fair and inclusive digital economy and to navigate the massive changes of the next half-century, we need to design, invest-in and deploy new open systems for everyone" (Open Systems Lab, 2020). One of their products, PlanX is a platform developed in collaboration with the CPC future cities division. It has been designed to automate and optimise the planning application process for citizens, stakeholders and local authorities. It exemplifies how digital social innovation can transform urban planning and will be discussed in relation to Coventry City Council in Section 3.1.

Within this context, this article will examine the emerging #PlanTech domain and the associated prospects and limitations for digital social innovators to deliver the next generation of 'Planning Support Systems,' suitable for integration into the smart city strategy of a medium sized local planning authority: Coventry City Council, UK. The remainder of the article is divided into five sections. The first section will outline the research question, methods and objectives for this article. The second will unpack the planning and local government context in Coventry and illuminate its efforts at digital transformation. The third section will look at the platforms proposed to aid digital transformation in the planning department. The fourth section will examine this case study within the broader trend towards smart cities and the role of digital social innovation on the delivery of #PlanTech. Finally, the conclusion will summarise the article and outline areas for future research.

2. Objectives

This article uses an ethnographic methodology (Brewer, 2000) to investigate how technology is increasingly being promoted to allow councils to deliver planning functions while adapting to austerity driven funding cuts and simultaneously improving service delivery and planning outcomes for stakeholders. Mixed methods were used including participant observation for a period of two months, 20 semi-structured interviews and five focus groups. Secondary data analysis involved document review of local plans, policies, and materials related to ICT, procurement and organisational performance, including reports and statutory publications.

Two research questions guide this study:

HQ1: What are the driving forces behind the adoption of technology as a means to deliver planning services in local authorities?

HQ2: What are the implications for planning governance and delivery in local authorities?

The aim of this article is to examine the motivations for employing technological solutions in the form of #PlanTech, and the subsequent implications for the profession. It aims to examine the role of planning technology as a driver of smart city strategy and place this transition within a broader socioeconomic context using a case study of Coventry City Council. As an emerging trend #PlanTech is an understudied phenomenon therefore this article will add to the literature regarding the policy driven digital transformation of urban planning.

3. Digital Transformation of Planning Functions at Coventry City Council

Coventry City Council is a Local Authority in the West Midlands region of the UK serving a population of 366,800 as of 2018 (Coventry City Council, 2020). It has responsibility for urban planning within the city of Coventry and statutory strategic planning powers alongside its neighbouring authorities to deliver on regional development requirements. Since 2010, Coventry Council, like all local authorities in the UK, has faced significant cuts to its funding from central government. Approximately 50% (£655m) of funding has been lost due to the Coalition government austerity policies which are designed to reduce the national deficit whilst still producing 'more for less.' This dramatic reduction in financial resources has led to organisational restructuring and reduced spending on public services in the city. Staff levels

across both planning teams has dropped by 33% since 2010 as a result of reduced budgets.

Planning in Coventry City Council is administered through two separate but interlinked divisions. The development management team processes planning applications, conducts planning enforcement and administers the Council's environmental health/protection functions. The planning policy team produces local development plans, conducts plan monitoring exercises and manages conservation and ecology issues in the council area. Since September 2018 senior management have been examining the planning workflow and processes to find efficiencies and cut costs, increasingly turning to technological solutions in line with the Council's digital strategy. Published in 2017 the 'Digital Coventry' strategy outline the Council's commitment to digital transformation, stating:

> The digital revolution matters to Coventry because digital changes create the opportunity for innovation and growth, improving the lives of Coventry's residents and helping the council to deliver outcomes in a more effective and efficient way, working with partners and residents. (Coventry City Council, 2017)

As a signatory to the Local Digital Declaration (Ministry of Housing, Communities and Local Government, 2018), Coventry has agreed to provide many of its services through digital formats. This is intended to allow the council to reduce operating costs while hopefully improving customer experience and satisfaction.

To facilitate this digital transformation, the development management and ICT teams at Coventry City Council have been investigating potential applications for digital tools in planning alongside the CPC and other private sector consultants. Private technology companies are currently the main providers of software and technological solutions procured by the council. The current organisational goal is to automate as much of the planning workflow as possible. This is intended to reduce the volume of administrative work that planners conduct, theoretically freeing staff to undertake more creative and skilled tasks.

3.1. Change, Technology and Procurement at Coventry City Council

Under consideration as of August 2019, the council has received proposals for the following: First, an AI powered 'Chat Bot' that handles customer queries related to planning. Offered by In-Form Consultants, a private UK firm, the product is designed to handle customer enquiries used data from the Council's website. In-Form state that the benefit of this product is its ability to handle unlimited enquiries, offering a much more efficient and cost-effective method over traditional human operators. In-Form Consultants have sold this product to other Local Authorities and state that one of their customers, Tower Hamlets in London, has seen a 310% return on investment in 2017 (In-Form Consultants, 2019).

Second, a 'Customer Relationship Management' system provided by Arkus Consultants and built on Salesforce infrastructure. The 'Customer Relationship Management' is designed to open up the Council's data, across all departments, and "connect everything, innovate experiences and deploy solutions in the cloud" (Salesforce, 2019). The 'Customer Relationship Management' will be a full front and back end system that drives service improvements while removing bureaucratic silos. A further product, Radian6, has been offered as a 'social listener' which analyses social media for activity relating to council business, offering an opportunity for proactive city management.

Third, Idox is a UK based technology consultancy that provides services to 90% of UK Local Authorities. They have developed solutions specifically for planning departments aiming for digital transformation that involves using AR/VR for engagement and consultation, AI for geospatial analysis, Blockchain for contract management and Drones for inspection, data collection and mapping. All the data generated by the systems will feed into a modern digitised smart planning service (Idox Group, 2019).

Private consultancies selling 'out of the box' products are not the only options. The CPC has stimulated research and development into the #PlanTech sector by providing funding and initiating competitions were tech start-ups, SME's and academia are invited to design digital products that can improve the UK planning system with technological and data-oriented solutions. A number of these initiatives have gained recognition as alternatives to the private sector options. Coventry City Council has been investigating the potential to integrate Open Systems Lab PlanX platform, which has been adopted by Southwark Borough Council in London, to automate the processing of planning applications. Open Systems Lab "is a non-profit R&D lab working on open digital innovation for industry and society" (Open Systems Lab, 2019). Working with the CPC and Southwark Borough Council, Open Systems Lab has developed PlanX to move the planning system away from a paper based, legacy system, towards a digital, streamlined and data driven system. Open Systems Lab works with councils to ensure that the system is bespoke and adapted to suit specific organisational requirements: "The most important thing about PlanX is that the guides (or 'flows') are written and controlled by councils themselves, putting planners in control" (Open Systems Lab, 2019).

The PlanX system aims to collate all the relevant policy documents and associated information that is pertinent for a particular type of development and provide it to the applicant. The online portal will guide each applicant through the application process, providing assistance and advice as the application progresses. This will streamline the application process for the applicant and

significantly reduce the workload of planners in local authorities. PlanX (Table 1) provides estimates of efficiencies the system will provide.

The cost of PlanX is determined by the size of the local authority. Prices range from £10,000 to £30,000 and are charged on annual subscription basis. Additional training and support is also offered as add on packages. Table 2 below shows the price range.

As a not-for profit organisation, Open Systems Lab have made the source code for PlanX free under a 'public service use' license. This enables local authorities without the financial resources to purchase a subscription to use the code to implement PlanX without paying for a subscription. Local authorities that wish to do this will need sufficient in-house expertise to adapt the software to their organisational needs. This could mean that planning staff are replaced by ICT staff, or planners are trained in these technical fields.

#PlanTech at Coventry City Council is still in its infancy, referring to the councils broader digital transformation, an ICT project manager explained "we are still in the early stages of looking at automation, we still don't have a back-end infrastructure in yet" (July, 2019). The council is currently in the process of installing a new 'back-end' ICT infrastructure, such as updated servers, operating systems and connectivity, that can support newer technologies, including 'cloud computing.' As such, the digital transformation of planning has not progressed beyond initial investigations into the potential solutions discussed above. In addition to the automation of development management, the CPC has also worked with stakeholders to produce tools that can inform planning policy, beyond the traditional methods. These tools include GrowthPlanner which is a tool that combines the intelligence held by utility companies and planners allowing both parties to assess the capacity of existing infrastructure for supporting developments. GrowthPlanner "combines models and visualises strategic information so utilities and planners can work closely together, today and in the future" (Future Cities Catapult, 2018, p. 16). It uses these models to identify where spare capacity exists on the network and highlights potential constraints such as flood plains and conservation requirements. Another example is 'Land Information Platform' which was developed in conjunction with the Department for Communities and Local Government. This tool uses machine learning to identify potential sites for development and aims "to draw together different data sources, urban modelling techniques and user workflows to support the development of more informed policies and decisions. It would provide planners, developers and citizens with a clearer view of the choices and trade-offs required of planning, as well as acting as a platform for others to build #PlanTech products and services" (Future Cities Catapult, 2018, p. 18). These prototypes offer examples of the #PlanTech that can aid the work of Coventry's planning policy team when they begin to engage with digital transformation.

4. Discussion

The financial crisis of 2008 and its implications for public finances paved the way for the 2010 Coalition government of the Conservative and Liberal Democrat parties to

Table 1. Projected workload efficiency for PlanX.

	Without PlanX	PlanX 1.0 Target	PlanX 3.0 Target
Phone and email enquiries	1000+ per month	50% by officers	5% by officers
Pre-application meetings	30min–1hr	5–10min	—
Reviewing small applications	1–2hrs	10–15min	—
Certificates of Lawfulness	30min	5min	0min
Invalid applications	50% invalid	—	0% invalid

Source: Open Systems Lab (2019).

Table 2. Price plans for PlanX annual subscription.

	Band	Decisions per year	Price	
	A	Up to 750	£10,000 + VAT	
	B	Up to 1000	£15,000 + VAT	
	C	Up to 1500	£20,000 + VAT	
	D	Up to 2000	£25,000 + VAT	
	E	Over 2000	£30,000 + VAT	
Add-ons	Editor training	Co-Writing	Testing workshop	Presentations
	£2,000 + VAT	£5,000 + VAT	£2,000 + VAT	£500 + VAT

Source: Open Systems Lab (2019).

pursue austerity policies that dramatically reduced public spending as a means of decreasing the national budget deficit. The constraints faced by local authorities created an opportunity for technology companies to design and deliver products that aid delivery of services with limited capacity. Increasingly, public sector organisations have adopted novel practices and tech solutions. This context provided the stimulus for technological innovation in the public sector, including the emerging trend in #PlanTech.

The political climate in the UK has major implications for planning and the public sector in general. Since Margaret Thatcher implemented neoliberal policies in the 1980s, the public sector has faced significant reductions in the funding received from central government when the Conservative party is in power. This has historically put major strain on the ability of local authorities to deliver core priorities and pushed some close to bankruptcy, such as Northamptonshire County Council in 2018 (Butler, 2018). Zuboff (2019, p. 49) writes that "by 2015, austerity measures had eliminated 19%, or £18 billion, from the budgets of local authorities and had caused 150,000 pensioners to no longer enjoy access to vital services."

Coventry City Council's corporate plan (One Coventry 2016–24) outlines the organisational objectives for the 8-year period 2016–2024. A key objective is to "deliver our priorities with fewer resources" (Coventry City Council, 2016, p. 8). The council is adapting to the current economic climate in the UK, one of austerity, by reducing operational costs through workflow optimisation and automation. As discussed earlier a 33% reduction in staff levels since 2010 has already impacted the planning team. This raises significant questions about the corporate rationale for digital transformation and potentially undermines any significant gain to the delivery of planning and planning outcomes through the adoption of #PlanTech. Automation of the planning workflow will free planners time and improve the team's performance against targets. This improvement may result in fewer planners being employed as the council aims to utilise resources in the most cost-efficient way. #PlanTech may be touted as a method to improve planner's ability to use their creative and professional skills, yet the actual outcome of this transformation may undermine the need for planners in local authorities and result in a further reduction in staff.

The shift towards ever greater technological integration can be traced by to the 1994 *Bangemann Report* (European Commission, 1994). Published by the European Commission it set the course for states and economies to use technology as a means of ensuring competitive advantage. It urges:

> The European Union to put its faith in market mechanisms as the motive power to carry us into the information age. This means action must be taken at the European level and by member states to strike down entrenched positions which put Europe at a competitive disadvantage. (European Commission, 1994, p. 9)

Explicitly encouraging the use of the market to develop and deliver technological solutions and products, the *Bangemann Report* encourages national states to foster technological innovation to ensure that they remain economically competitive in the global market. The government of the UK, along with other EU member states and other nations, has embraced this recommendation and produced policies to aid the delivery of an information economy. Working with private sector companies through public–private partnerships, the government has so far delivered an infrastructure including fixed line broadband, with plans to upgrade telecommunications networks to 5g standards to support the information economy and contracted the development of digital public services to technology companies.

How #PlanTech will impact planning is still an open question. The CPC team leader for #PlanTech stated the rationale for focusing on planning innovation:

> Planning is behind the times. Digital is affecting the places we live and the people who live in these places. No-one was operating successfully in this sphere and the market was not delivering or innovating in this area. Digital innovation in planning is necessary to provide good places in future cities. (November, 2019)

Coventry's early stage of transformation shows a potential crossroads, on the one hand public-private partnerships are increasingly being used to deliver public services through privately designed and rolled out solutions that automate workflows and other planning tasks. As planning departments in local authorities continue to adopt digital solutions and practices that are designed and maintained by private companies, it is feasible that many planning tasks are performed by software rather than planners. In this scenario it is reasonable to anticipate local authorities delivering urban planning through a form of neoliberal technocratic partnerships with private digital companies, many of which already have significant interests in legacy IT systems used by these local authorities. On the other hand, there is potential for organisations like Open Systems Lab to gain a foothold in what is expected to be a rapidly growing sector. The use of not-for-profit digital social innovators could offer an alternative to the public-private partnerships delivery mechanism. By engaging digital social innovators and the third sector to design #PlanTech that incorporates the needs of communities and citizens and utilises the insights that technology can deliver, local authorities could produce better planning outcomes.

Local authorities using digital social innovation to design and deliver services will also contribute to establishing the principles that define a smart city. The Vienna University of Technology (2007) defined these principles as: 1) smart economy—a competitive, glob-

ally integrated economy based on innovation and entrepreneurialism; 2) smart people—citizens are educated, engaged and committed to public life and lifelong learning; 3) smart living—urban life promotes health, culture, cohesion and progress; 4) smart environment—natural resources are protected and managed to flourish; 5) smart governance—people are involved with public agencies to aid better delivery of services; and 6) smart mobility—open, accessible and low carbon transport promotes mobility.

PlanX indicates how digital social innovation can deliver on these principles, specifically smart economy, smart people and smart governance, and other digital social innovations in #PlanTech could assist in delivering the remaining living, environment and mobility principles. Government coordination and support will key to the success of digital social innovation in #PlanTech and a smart city based on these principles, however, current governance arrangements are likely to pose a barrier to adoption. Urban planning as a function of local government is embedded in the institutional and regulatory frameworks that oversee the performance and compliance of these organisations. Often a complex and interdependent regulatory regime exists which entrenches practices within local authorities, stifling innovation and change. One example of the many barriers that digital social innovation faces in delivering planning functions is that currently all local authorities in the UK must receive accreditation from the Public Services Network with regard to use of IT software and equipment to manage the associated risks with these systems and storing personal information of thousands of local residents. An IT manager at Coventry City Council stated that "without this accreditation the council cannot accept online payment or offer many of its digital services. It is essential to the functioning of the council" (May, 2019). In 2017 the government stated that the Public Service Network accreditation will be eventually phased out which could allow digital social innovators to design solutions that deliver public services, however, many other restrictions and barriers remain.

5. Conclusion

An increase in the uptake of planning technology is likely to have impacts on how planning is performed in local authorities. There is growing acknowledgment that the planning system in the UK is not fit for purpose and needs significant reform (Airey & Doughty, 2020). Top down policy from central government regarding digital transformation is a major driving force behind the #PlanTech ecosystem. Along with other public services, technology is increasingly seen as a desired and optimal method of delivering planning and unlike the 1960s trend for 'systems and rational' planning, the contemporary focus on #PlanTech is based on an economic transition into the information economy (Castells, 1996). In the UK, the CPCs work with small-medium enterprises, not for profit organisations and local authorities to develop digital solutions that can enhance planning services and outcomes for communities will be vital for motivating and guiding digital social innovation in #PlanTech. This will feed into the smart city strategy being implemented by local authorities across the country. In Coventry there is evidence that the initial phase of #PlanTech will seek to automate administrative tasks including the processing of planning applications. This should create efficiencies that translate into better plan-making were staff have more time to focus on the creative and skilled areas involved in the profession. Fundamentally, it is important to consider the political and regulatory climate in which local authorities operate. For example, the European Union's General Data Protection Regulations (European Court of Justice, 2019), Article 22(1) states that "the data subject shall have the right not to be subject to a decision based solely on automated processing, including profiling, which produces legal effects concerning him or her or similarly significantly affects him or her." This provision means that despite the use of automated processing software for planning applications, the final decision must be made by a planner. By keeping a 'human in the loop,' planning decisions will still ultimately be made by planners. Whether this clause or one like it will affect #PlanTech after the UK definitively leaves the European Union is uncertain. Many other regulatory and governance issues that inhibit or restrict the adoption of digital social innovation remain, identifying and overcoming these is a necessary focus of future research.

Overall, this article identifies how the policy objective of digital transformation of planning is being tackled by a medium sized UK local authority. The case study analysis highlights the competition between technology vendors for contracts, and also the challenges faced by digital social innovators such as Open Systems Lab when it comes to gaining a foothold in the process of planning's digital transformation. Among planners there is a clear appetite for utilising the skills and services of digital social innovators, but there appears at present to be a number of policy conflicts which prevent the widespread adoption of digital social innovations to address the constraints facing planning departments as a result of austerity driven budget cuts. An example of this clash of policy is the EU and UK government backing of digital social innovation as a driver of innovation, yet in practice governance and legal requirements such as the Public Service Network accreditation act as a barrier to entry for these organisations.

The adaptable and bespoke technological solutions offered by digital social innovators such as Open Systems Lab offer a novel and productive toolkit that may increase performance beyond the capabilities of 'out of the box' solutions from multinational vendors, therefore it is recommended that the current governance and legal frameworks are adjusted to enhance the ability of these organisations to enter the marketplace for planning technologies with UK local authorities. Removing these bar-

riers of entry could spur further innovation and interest, enhancing the quality of technological solutions and thus the planning advantages and outcomes for planners, local communities and stakeholders.

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Conflict of Interests

The author declares no conflict of interests.

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Article

Innovators in Urban China: Makerspaces and Marginality with Impact

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Abstract
In China, the emergence of makerspaces, hackerspaces, Fab Labs, and innovation labs reflects top-down and bottom-up dynamics. The grassroots movements and governmental efforts promoting innovation and creativity are part of the maker trend linked to the rise of the Internet and access to digital tools. The urban imaginary of the maker culture creates networks and events both globally and locally. The first makerspaces opened in Shanghai and Shenzhen in 2010 and attracted the attention of the government, which published an initiative in 2015 that influenced the typology of makerspaces in China. The ephemeral spaces for innovators, hackers, makers, and entrepreneurs shaped by this cultural context and local ecosystem are urban phenomena investigated with social anthropological and experimental methodologies to better understand the extension and platformisation of these autonomous and co-opted communities and narratives. This research fills the knowledge gap on makerspaces in China in recent years, showing the impact of governmental initiatives on a grassroots culture, the possible roles of makers, and the complexity and unlimitedness of the maker culture through international partnerships for projects such as Designed in Ethiopia and Kabakoo Academies.

Keywords
Africa; change-makers; changing narratives; China; empowerment; innovation; makerspaces

Issue
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1. Introduction

The last few years have seen a proliferation of numerous types of makerspaces, hackerspaces, Fab Labs, coworking spaces, accelerators, and incubators (Troxler & maxigas, 2014), all of which bring alternatives to well-established infrastructures, generating new dynamics. Not only do they introduce a new idea to the structure of work and hobby (Wen, 2017, p. 7), they also blur the lines between professional and private activities. Dual categories such as public/private, individual/collective and offline/online, are to be rethought as they are generally limited by their boundaries, and do not represent the hybrid liminal spaces that makerspaces offer. 'Makerspace' is a concept uniting many types of spaces and activities under one umbrella where all kinds of profiles (objectives, languages, and skills) are mixed. The rhizomic (Deleuze & Guattari, 1987) characteristic of the maker culture is inspirational and affects makerspaces (places, people and politics), urban fabric (urban integration, empowerment, ecosystems and identities), and outreach (projects without borders, partnerships and business).

Manual work is not novel, but the revival of this making, do-it-yourself (DIY), tinkering and tech enthusiasm, and trend, make it more palpable. According to A. Smith, globally, the process of democratising innovation also takes place with makerspaces, they are: "[A] site of struggle over profound issues material to social futures, and hence an example of innovation democracy in action" (Smith, 2017, p. 14). But also, innovation needs support from peers, groups or networks as Akrich, Callon, Latour, and Monaghan (2002) write: "Innovation is perpetually in search of allies. It must integrate itself into a network of actors who take it up, support it, diffuse it" (pp. 203–204). Makerspaces are 'social innovation niches' (Pel & Kemp, 2020) beyond products, con-

nections between people and partnerships are the key. Indeed, makerspaces are empowering members of communities and their networks (Shorthose, 2004).

Urban farming, drone evenings, plastic recycling, robot competitions, watchmaking, kids' lamps, laser-cut masks, cup printing and painting, silk screening, prototyping for one's projects or external mandates are part of the activities of makerspaces in Shanghai and Shenzhen where fieldwork was conducted. This article is based on a four-year social anthropological research (2016–2019) with intensive fieldwork and over 50 interviews mainly in the Shanghai and Shenzhen maker environments. The classical social anthropological methodology is completed by experimental multidisciplinary workshops with expert and public participants exchanging knowledge and making (methodology, maps, zines) together (Bolli, Renaud, Bloch, & Protti, 2020). Surpassing classic research methodologies and creating multi-sited, fast-changing and multi-layered narratives of research is important and challenging (Driessen & Jansen, 2013; Holmes & Marcus, 2008; Pink, 2015). Based on interviews, Chinese governmental websites, makerspaces' social media and academic publications, I show how urban social innovators influence or are influenced by their environment. The Chinese government's turn towards innovation has changed the path and typology of makerspaces in China without creating a revolutionary elite or erasing the existing grassroots culture. Makerspaces have an impact on personal lifepaths and globally connected projects; they have been praised (Lindtner & Li, 2012) and their instrumentalisation underlined (Wang, 2016) and criticised (Shea & Gu, 2018). Showing their path, complexity and narratives in the context of urban China gives a voice to makers and fills the knowledge gap, showing their potential for impact.

Here, to contextualise the topic I first present the 'makers in China' showing a timeline of this young phenomenon and discussing the complexity of interpretations of concepts and translations, specifically for *chuangke* (创客) part of 'maker' (创客人) and 'makerspace' (创客空间). I then discuss the typologies of spaces and places developed in the framework of this field-oriented research before coming back to its core, the role of the makers. I then turn to the Chinese urban narratives before opening up the topic to the outreach of social innovators in urban China.

2. Makers in China

The global maker culture, linked to the concept of DIY (Day, 2016; Gibb, 2015; Huang, 2017), has experienced an explosive success with the growing access to the Internet, therefore facilitating the knowledge exchange, personal fabrication, and access to tools (Anderson, 2012). This narrative connects hobbyists and entrepreneurs enthusiastic of manual work. The maker culture in China is young, experimental and ephemeral. In China, the first makerspaces appeared in 2010–2011 with XinCheJian in Shanghai, Chaihuo in Shenzhen, and Beijing makerspace in Beijing. The three spaces still exist but have changed, shaped by the "boom and bust of makerspaces" (Xue, 2018). Maintaining a community and minimal financial stability are both key challenges. The non-profit business models are endangering the survival of makerspaces in terms of sustainability. Yet, these collaborative spaces, combining individualistic and shared projects, in a non-hierarchical organisation, caught the government's attention. As innovation enablers, first on a local and, if successful, on a global level, makerspaces were perceived as having the potential of supporting a changing economy and creating successful entrepreneurs.

2.1. A Young Fringe Phenomena

Considered as a 'fringe phenomena' (Troxler & maxigas, 2014), the rather marginal maker culture inscribes itself in a 'maker culture imaginary' (Shea & Gu, 2018, p. 54) where narratives shape concepts and places. The maker culture which I write about started growing in China step by step with different actors. Following the opening of the first makerspaces, the annual public maker activities commenced with carnivals and fairs in 2012 as shown in Figure 1. In the continuity of the first makerspaces, more opened in 2013 and 2014. In 2015, the Chinese government positioned itself by promoting the *chuangke* maker-entrepreneurship initiative (Marshall & Rossi, 2017) and launching officially supported events resulting in the spread of the maker culture in China that climaxed in 2015–2016 with thousands of spaces in the country according to a news channel relaying a piece of Chinese governmental information ("China has ranked first," 2017). While some data write about thousands ("China has ranked first," 2017; Xue, 2018), others reveal around 100 active spaces at the mentioned peak (Kingsley & Saunders, 2016). The dichotomies between these references are not research-limiting, providing an opportunity to showcase discrepancies of the maker culture narratives. The definition of the makerspace does vary: is it the number of autonomous communities prone to experimentation (hobbyists/freelancers), the professional quasi-incubators, or the companies with a makerspace in their offices?

The Chinese government's interest has encouraged makerspaces pushing for a transformation and a reinterpretation of the trend: "The government's initiative has, in the long run, reduced the number of makers as it has transformed the idea of maker into entrepreneur" (Xue, 2018). Despite the peak in the number of makerspaces reached shortly after the 2015 governmental experimental initiative, the maker culture, revitalising and restoring hands-on work, is marginal as it counts a few spaces in each city which remain in the experimentation that does not purely aim at incubating new products. Such marginality, here in the sense of rarity and in opposition to the narrative of the booming move-

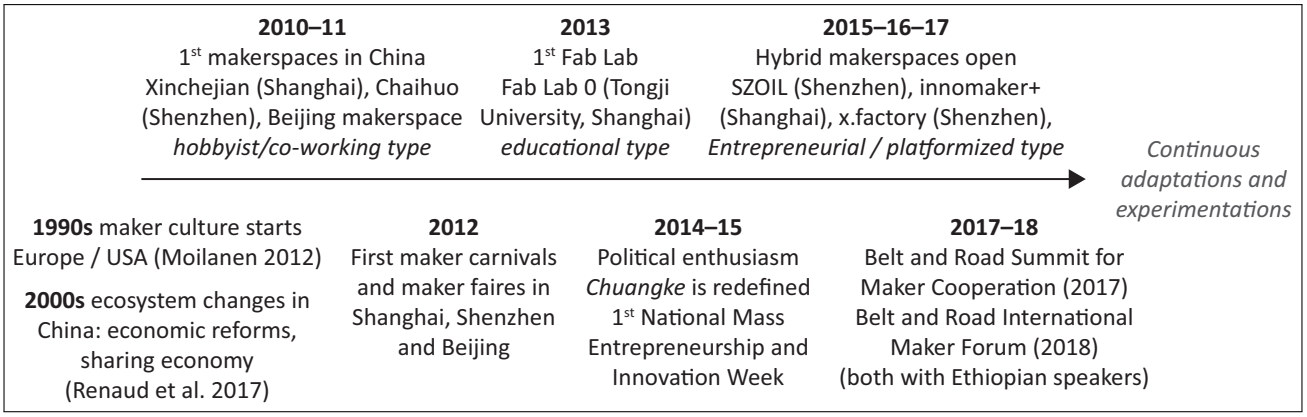

Figure 1. Makers in China timeline. Source: Bolli (2020).

ment "nurturing the next wave of Chinese innovators" (Ma, 2015), represents freedom of experimentation for those involved. The risk of institutionalising ephemeral structures of change is to not allow their natural evolution and failure opportunities by pushing entrepreneurship. It is a new type of culture, which keeps adapting.

The specificity of makers in China is that the government recognised the potential of makerspaces fitting in a changing ecosystem and representing a possible drive towards economic success, but for a short moment only. The translation and co-optation of the maker culture in China has created multi-faceted types of makerspaces born from bottom-up and top-down dynamics. After the governmental enthusiasm expressed, different trends have emerged, such as professional-oriented makerspaces accepting only already skilled makers as x.factory Shenzhen or innomaker+ in Shanghai, or platformised makerspaces collaborating online and welcoming teams or projects from anywhere in the world as the Shenzhen Open Innovation Lab (SZOIL) and x.factory in Shenzhen, and which have widened the types and possibilities of partnerships. Rather than replacing one typology for another, the typology of makerspaces continues to diversify with trends and community interests. This official accent on entrepreneurship is what differentiates the maker culture in China from other countries (Wen, 2017). In 2017–2018, several grassroots projects kept growing between the Shenzhen entrepreneurial and platformised makerspaces and makers in African countries (see examples in section 5.2).

2.2. Definition of Chuangke and the 'Lost in Translation' Effect

What all makers share is an attraction for self-making or self-accomplishment. Doing is of great value. The 'homo faber' (Lallement, 2015) resuscitated by hobby, the craftsman turned 'outward' by craftwork, where the "value of experience [is] understood as craft" (Sennett, 2009, p. 288), the "people who regard technology as an invitation to explore and experiment of, with the most inclusive possible definition of technology, meaning any skill or technique that we learn and employ" (Dougherty & Conrad, 2016, p. xv), or as cited by Wang: The ones "devoted to innovation passionately" and "who control the production tools themselves" (Yu & Deng, 2015, p. 46), or the ones who are going to realise the collective dream of the Chinese nation (Keane & Chen, 2017; Lin & de Kloet, 2019).

If the maker culture is global, translating its vocabulary adds dimensions that need to be taken into account. While the term maker as used in English is very wide and includes anyone from those who tinker to engineers, the Chinese term is more precise. *Chuangke ren* (创客人; maker), and *chuangke kongjian* (创客空间; makerspace) have developed from an open concept to referring specifically to entrepreneurs or freelancers who start their own business or develop innovative ideas. *Chuangke* (创客) is composed of two characters, namely, *chuang* (创; start something or achieve) and *ke* (客; guest or visitor), the first is for example also used in *chuangxin* (创新; to innovate, innovation) including the character *xin* (新; new, fresh; see Bolli, 2020; Renaud, Graezer Bideau, Bolli, & Laperrouza, 2017). Even though the term *chuangke* is not always translated and used in mandarin Chinese, it is essential in the shaping of the Chinese maker culture. Not only are spaces influencing definitions, the definitions are also translated into ideologies of spaces that have been spreading worldwide. The positive connotations of *chuangke* in Chinese serve a precise purpose as they are "employed in positive terms in political and public discourse as a way to foster social change and technological innovation" (Lindtner, Hertz, & Dourish, 2014). *Chuangke* was chosen to define makers for its positive connotation but is now not only used for makers but also for entrepreneurs or businesswomen/men. Even if the *chuangke* mindset is not clearly defined, it is inclusive in forms of innovative hands-on projects carried out by individuals who will, if the project works well, possibly develop it into a full-time activity. It carries ideologies of empowerment through learning and doing, social change, and development. When we write about makers in China, we need to include the linguistic enrichment achieved by translating the concept back. Adding a layer

to the concept of maker, especially when doing fieldwork in China, can lead to misunderstandings as using *chuangke* can be interpreted as entrepreneur by some, businesswomen/men by others and maker by those who are part of the maker culture. As explained earlier, in Chinese, concepts are constructions of characters which evolve and can be interpreted in various ways, providing also options to manipulate, redefine and adapt to a given reality.

Adding to this, *shuangchuang* (双创), an abbreviation of the 'Mass Entrepreneurship and Mass Innovation' slogan, is an instrument used to spread entrepreneurship; it reunites the concepts of entrepreneurship and innovation (Renaud et al., 2017); it challenges or even contradicts the original concept of makerspace in which the autonomous and empowered individuals are placed at the centre. From a more hobbyist and freelancers' perspective, the concept evolved into early incubators, accelerators, company innovation hubs, international prototyping platforms, and businesses. On the one hand, it has altered the original definition of makerspaces, and on the other created an additional one more focused on success and economic benefits.

Translating words also means reshaping concepts and realities. It allows us to willingly, or not, incorporate additional interpretations and meanings, and also to remove the inconvenient ones. The maker culture in China was inspired to pragmatically create a new meaning adapted to its needs and ecosystem. Free time and hobbyist activities are rather new concepts in China (Huidi & Er, 2009; Wang, 1995). Makerspaces and their communities are at the interface of hobbyism and entrepreneurship, with a serious interest in DIY and education. The marginality of the culture and its economic insecurity is a challenge for communities' sustainability and engagement. At the same time, the opportunity to try new things, with rather low stakes, is unique. The lack of Chinese political enthusiasm for makerspaces and its integration in urban narratives did not stop the natural process and ephemerality of these spaces but diversified its typology.

3. Typologies of Places and Spaces

The areas of interest for this research do not belong to a defined category of type of place. They are at the crossroads of places where one can work, learn, play or develop a business. Theories about third and fourth places, therefore, support the discussion and attempt to situate makerspaces, their role and opportunities.

The thirdness of space as proposed by Bhabha (1994), Soja (1996), Oldenburg (1999) widened academic discussions and the understanding of space beyond the duality of public and private spheres or home and work. It opened possibilities for self-definition, otherness, and enjoyment. The in-betweenness described by these authors corresponds to the place in which makerspaces evolve but is, at the same time, insufficient. Morisson (2018, p. 445) goes one step further by developing a 'fourth place' theory:

> In the knowledge economy, the rise of new social environments is blurring the conventional separation between the first place (home), the second place (work), and the third place. New social environments in the knowledge city can combine elements of the first and second place (coliving); of the second and third place (coworking); and of the first and third place (comingling). Furthermore, the combination of elements of the first, second, and third place in new social environments implies the emergence of a new place, the fourth place.

Makerspaces belong to Morisson's category of fourth place. The not-fully-defined concept of makerspaces reflects the position of its members and users. They are not purely different, they are parts of all three places, and at the same time allow a unique place to develop (Bolli, 2020). Makers are at the crossroads of co-living, comingling and co-working in their projects and exploration of a new lifestyle. Makerspaces are and have evolved into a fourth place with access to the Internet, the knowledge economy and circulation, and the search for new places representing alternatives to systems in place. The chronological evolution of the global maker culture with, among others, digital changes, has shaped and modified the role and place of makerspaces. They are not just the 'other place' apart from home and work, they combine elements of this first, second and third place. Passionate members mostly live, work and mingle in their makerspace as their project often becomes the priority. I observed three non-exhaustive main types of makerspaces during the research: 1) hobbyist/co-working spaces such as xinchejian and xinfab in Shanghai, 2) educational spaces such as Fablab 0 in Shanghai and Litchee Lab in Shenzhen, and 3) entrepreneurial/platformised spaces such as x.factory and SZOIL in Shenzhen (Bolli, 2020). While hobbyist/co-working makerspaces are initiated and supported by grassroots communities, educational and entrepreneurial/platformised makerspaces are supported by institutions, local governments or private companies often born from mixed initiatives. Financial and group stability are challenging to these spaces, and especially for the hobbyist/co-working types which rely on their communities.

Since the categories are intricate and permeable, they give a rather schematic understanding of the third and fourth spaces encountered in China but help define the status, priorities or intentions of the makerspaces. Each space embraces most of the different aspects in different ways. In addition to the tension created by the categorisation of the spaces, the notion of platformisation that opens places vertically for worldwide accessibility, and also fulfils the Chinese government's agenda needs to be underlined. Lin and de Kloet have investigated the emerging Chinese creative class that is part of the rapid

platformisation of Chinese cultural production and accommodates the state's "'entrepreneurial solutionism,' while also producing digital creative entrepreneurship among Chinese 'grassroots individuals' and a dynamic digital culture permeated with contingency and negotiation" (Lin & de Kloet, 2019, p. 2). Entrepreneurial solutionism describes the idea that developing a certain field, here entrepreneurship, is the solution for social and economic problems, moving the country closer to its dream of 'national rejuvenation' (Keane & Chen, 2017). Digitalisation and platformisation, part of this narrative, add dimensions to the typologies of makerspaces, to the worldwide integration of people and projects, and also to the governmental priorities.

4. Role of the Makers

Even if often perceived as innovators for their products or projects, makers are innovators for their disruptive ways of working and developing projects, using the urban environment and ecosystem. To better understand their role, we will look at three aspects of their often-attributed identities.

4.1. Revolutionaries?

Anderson's book *Makers, the New Industrial Revolution*, published in 2012, shed light on a culture of innovators and entrepreneurs empowered by the Internet. For China, Lindtner seems to agree that the "maker culture is envisioned as an enabler of the next industrial revolution—a source of unhindered technological innovation, a revamp of broken economies and educational systems" (Lindtner, 2015, p. 1). This teleological view serves the purpose of the maker movement ideology and reinforces it. The challenge with this type of classical narrative is that it has shaped or even been embraced by the Chinese government, deploying "resources and efforts to develop makerspaces to accelerate the cultivation of the new driving force" (State Council of PRC, 2016). Wang (2016) has a more critical approach to the matter in her article "The Makers Are Coming! China's Long Tail Revolution." The latter can also be read with some irony, as she underlines either the utopic or dystopic role of citizens on China's road to innovation. While some researchers write about making the "next industrial revolution" (Troxler, 2013, p. 181), others wonder if makers are on the 'path of post-capitalism' (Berrebi-Hoffman, Bureau, & Lallement, 2018, p. 12), and others underline the instrumentalisation of the makers by city governments (Shea & Gu, 2018, p. 4). If instrumentalised, are makers part of the new elite?

4.2. Elitists?

Depending on their results, makerspaces are places for what could be classified as tinkering, self-developed projects and innovation. Nevertheless, as mentioned earlier, I consider the innovation to be in the renewal of workspaces and organisation, in the freedom taken to follow a personal idea or project and with a government both attentive and reactive to their emergence but not especially to the products which could be marketed. The Chinese government aimed to create new spaces for new types of economic activities to emerge and be ready to launch experimental initiatives for it. Urban policy experimentations through pilot projects are part of the Chinese urban planning tradition (Heilmann, 2008) and the non-renewal of such an initiative is not surprising. The co-optation of the makers has not led to any major revolution or change in the economy or society on a large scale but has changed the lifepaths of those joining the communities.

In general, the non-hierarchical position of these spaces allows each member to remain independent, while at the same time being part of an infrastructure where they can contribute to its development and learn from and be inspired by others. This maker spirit of accessibility to everyone whether skilled or unskilled is not always applicable. Writing about makerspaces in the USA, Davies explains that the community has a sense of "being an elite subculture" (Davies, 2017, p. 146). The access to makerspaces for the wider population can be limited due to the stratification of the population in terms of information, knowledge, interest, time and income. Progressing to the next level shows that even a smaller portion of the already knowledgeable makers will be able to create more and better projects as Shea and Gu write criticising the idea of egalitarianism in the Shenzhen maker culture (Shea & Gu, 2018, p. 86). This elitism creates a form of marginality of the movement, but this selectivity is not entirely restrictive. All kinds of profiles can be found in makerspaces, even if the majority are engineers, designers or technology savvy.

Understanding both the openness and limitedness of makerspaces in terms of accessibility does not change the path and lifestyle of the makers. Such individuals are on a liminal path of self-development, social change and national transformation. They are part of a marginal, ephemeral and liminal culture or group that has a potential positive impact for themselves, their surroundings, society or even further the country. As Wang mentions, the Chinese government has not been blind to this: "Whether we are speaking of maker entrepreneurs or makers as change-making citizens, it is obvious that the government has discovered the value of the individual, creative expression and grassroots energy in transforming Chinese economy and society" (Wang, 2016, p. 59).

In its 2015 political strategies, the Chinese government recognised the need of individuals, such as makers, to create a new form of entrepreneur-elite (Marshall & Rossi, 2017; Wang, 2016; Yu & Deng, 2015). Makerspaces are terrains of opportunities which were supported or even instrumentalised by the Chinese government and seem to be a place for a new techno-entrepreneurial elite (Hoffman, 2010). Nevertheless, even if the people

who are part of the maker culture in China are well-educated, young and ambitious, it does not limit them and their lifepaths to the government's influence.

In general, makerspaces are liminal places and spaces institutionalised and legitimised through ritual moments and rites (Bourdieu, 1982, p. 58), where people work on their skills or their lives before taking the next step. Also, makers do not describe themselves as makers but mostly by their skills/profession (engineer, designer, etc.) or projects (urban gardener, teacher). Fieldwork shows that they are part of a narrative that they are often not aware of, but are part of the dynamic of change (Bolli, 2020). The etic and emic viewpoints are in tension. Called makers from an etic perspective, they define themselves, from an emic perspective, as engineers, freelancers, designers, students, artists, or curious persons that found a place where they could work or create their projects and share time and space without thinking of the wider ideal. Their impact is therefore double, through their projects and the surrounding narratives.

4.3. Change-Makers

Makerspaces in China have a transitive function and an ephemeral existence. In the urban structure built by transportation functions and buildings, which can change (but not as fast as what exists intra muros), makerspaces are particularly dynamic elements which can evolve from one day to the next due to changes in the community, lack of funding or the need to move to a new place. The imaginary which surrounds these spaces and their urban concentration is important. A city can be observed for its physical existence (roads, buildings, etc.), its life (events, etc.), its people (citizens, migrant workers, travellers, politicians, dreamers, etc.) and its dynamics (changes, migration, openings/closings). These liminal spaces of making are an urban phenomenon taking place at the crossroads of these mentioned elements. The interest in makerspaces changes over time as individuals and groups of people transit through them, and politics and governmental initiatives evolve. With rapid urban changes and, therefore, a context on the move, people are keener to go through their own transitions. According to Berrebi-Hoffman et al. (2018), makerspaces are vectors of innovation despite their possible discrete existence. They are at the origin of a cultural movement in the USA and Europe, of transformation and experimenting with new forms of fabrication linked to the access to tools and knowledge (Berrebi-Hoffman et al., 2018, pp. 18–20).

The impact of the makerspaces is in the lifepaths of its participants. They are social innovators and change-makers experimenting with ideas and work styles. The strength and impact of makerspaces currently lie in their marginality and set a blueprint for the future. According to John, the legal representative of xinchejian in Shanghai:

> The makerspaces for now almost disappeared because of the rush towards subsidy [linked to the 2015 governmental initiative], these spaces are not profitable so people rush to the next place/trend. In the future, there will be more acceptance for alternative spaces….The real movement is in the future when people think they need this community to support.

Like many others who are part of the maker culture, John has 'hacked his life' and sees an opportunity for systems and lifestyles to change. The autonomy of makerspaces is purposefully generated and enables people to choose what to learn, how and when, and is integrated into a global open digital context.

5. The Unlimitedness of Space for Urban Social Innovators

From grassroots to co-opted, to hybrid spaces, the maker culture keeps evolving and adapting to opportunities encountered by urban social innovators. The very dynamic Chinese urban settings accelerate the success and failures of initiatives. Through digitalisation and platformisation of places, makers are not only experimenting in their urban environments, they are also sharing this environment with grassroots partnerships.

5.1. Chinese Urban Narratives

The Chinese urban fabric is a fertile ground for experimentation. National and international dynamics meet in the mega-cities of Shanghai and Shenzhen with the Chinese, those Chinese who have lived abroad, and foreigners. In China, the top-down approach seems to dominate, but the actual dynamics are a game between top-down frameworks and bottom-up initiatives and stakeholders finding ways to profit from the existing frameworks (Renaud, Fernandez, Puel, & Feng, 2019; Zielke & Waibel, 2015). In the case of the makerspaces, they have been appearing in China since 2010 and have had to negotiate their position and existence in each city. The story of the makerspaces in China is part of the period in which the country's narratives shift from 'made in China' to 'make' or 'created in China,' and 'innovated in China' (Keane, 2006; Wei, Xie, & Zhang, 2017). While the Chinese government was focusing on innovation and creative clusters, and therefore opening opportunities for makerspaces to exist, the latter were being incubated in the cities. Makerspaces can be part of creative clusters (Wen, 2017). They have inserted themselves into the urban fabric of each city in many different ways and places and have found niches that have enabled them to be recognised. The top-down initiative of the government reached out to the municipalities and cities, which implemented it depending on their local infrastructure and interpretation. Each city developed local strategies and adapted top-down initiatives uniquely. Shanghai, where the first makerspace in China opened,

has remained more hobbyist while Shenzhen has become a more professional and platformised maker culture linked to the city's export and fast-production history. Shenzhen's identity is now linked to creativity and innovation (O'Donnell, Wong, & Bach, 2017).

Makerspaces are part of the intensity of the urban fabric in China. They may be ephemeral and marginal, but their networks are international and can create many dynamics and new projects on local, national, and international levels. The emergence of platformised makerspaces, especially in Shenzhen, has also given additional dimensions to the culture, which is opening the city and fluidifying personal networks. Through the accessibility through the Internet, makers worldwide are benefitting from knowledge exchange and new partnerships to develop their own projects. In Shenzhen, this is made visible by several events. The maker fair, recognised internationally, which has taken place since 2012 and is organised by chaihuo and now x.factory is also one of them. It attracts visitors from all over the world who are fascinated by this 'new Silicon Valley' (Lindtner, 2015, p. 858) and the opportunity to learn and potentially later work with local entities accessible through the hybrid makerspaces. This event is organised by grassroots makerspaces backed by a private company and supported by the local government. Another example is the International Maker Cooperation Summit and Forum which took place in 2017 and 2018, and to which Ethiopian speakers who are connected to the initiative Designed in Ethiopia (Xie, 2017, 2018) were invited. These Summit and Forum, organized by SZOIL, an entrepreneurial/platformised makerspace, took place in the framework of the National mass entrepreneurship and innovation week in Shenzhen. In this specific case, the project was initiated by a maker who sought for SZOIL partnership. The co-optation dynamic is bottom-up and is part of a strategy of outreach, recognition and financial support (Bolli, 2020).

5.2. Global Connections

Maker communities create new types of collaborations to implement their visions, and China has supported makerspaces also to implement a new vision which has hybridised their essence. This combination has created a unique image. Different countries are looking at China, and more specifically Shenzhen, as a model of innovation, economic renewal, and industrial production. Shenzhen's re-branding from a 'made in China' to a 'make in China' label is internationally recognised. The Chinese maker *chuangke* has an imprint on global maker projects linked to local Chinese makerspaces through partnerships and cooperation. Projects like Designed in Ethiopia and Kabakoo Academies partner in different ways with Shenzhen-platformised makerspaces. The enriched re-translated definition of *maker* corresponds to the change-making impactful makers of these projects in Addis Ababa and Bamako.

The interest of Ethiopian entities (makers, government, etc.) in such knowledge exchange is an example of the outreach of Chinese technologies and ideologies through innovation communities based in Shenzhen. Organisations like SZOIL and x.factory have benefited from the Chinese national interest in projects involving multidisciplinary exchanges, open innovation, and possible entrepreneurship. Experimental initiatives such as Designed in Ethiopia are the seeds for new dynamics between grassroots and governmental cooperation. This project, initially launched by an Ethiopian student in China in cooperation with iCog Labs in Addis Ababa, the SZOIL in Shenzhen and later the Ministry of Science and Technology of Ethiopia, has reached Ethiopian enterprises, universities, and governmental entities awakening interest, participation and support. The local communities involved have been proactive and have attracted the attention of the Ethiopian government, which started supporting and partly co-opted this grassroots initiative officially launched in March 2018. From 1,200 projects submitted by Ethiopian students, 100 were selected and invited to intensive training sessions led by Shenzhen-based experts who had been invited to Addis Ababa. After the training was completed, 5 projects were chosen. At the moment, these projects undergo patent applications, and the winners should be sent to Shenzhen for prototyping and to learn from the Shenzhen maker-entrepreneurial environment. The strength and uniqueness of this project lie in the potential of empowering youth in Ethiopia locally, by opening up to learning from others, here the maker environment in Shenzhen. One of the future goals is also to switch from a 'designed in Ethiopia' and 'made in China,' to a 'designed in Ethiopia' and 'make/made in Ethiopia' label.

Another project linking makers in Africa and China is Kabakoo Academies. It is a unique project led by local makers in Mali and other locations where individuals can learn new skills, prototype and manufacture on a small scale. Kabakoo collaborates with organisations such as x.factory through knowledge exchange by mentoring and distance education, through specific projects such as West Africa's first citizen platform monitoring ambient air pollution to which Seeed Studio (of which x. factory is part of) provided part of the materials. This cooperation is mutually beneficial as Kabakoo participants learn from Shenzhen-based organisations and receive some material, and Shenzhen-based organisations get direct feedback on product performance in local environments.

These are strong albeit rare examples of ambitious and successful grassroots projects linking Chinese and African makers (Hailemariam, 2019; Kabakoo Academies, 2019; SZOIL, 2019). Both project launchers were students in China benefitting from educational cooperation between their countries. In this specific context, China is a source of inspiration or a partner for empowering projects. Knowledge, technologies, and discourses between China and African countries circulate in complex ways, not as unidirectional, straight-forward

and top-down as often assumed. According to Brokaw, a contributing editor to MIT's *Sloan Management Review*, China has become the 'World's Innovation Role Model' (Brokaw, 2017) and an important hub for entrepreneurs and makers. Without confirming or contradicting Brokaw's thought, observing the grassroots maker interactions shows a potential of inverting trends and influencing the future through innovators.

6. Conclusion

The young and fairly marginal maker culture in China has diversified over time from mostly hobbyist/co-working makerspaces towards more educational and entrepreneurial places with the influence of a governmental initiative of 2015 that was not renewed. The latter supported entrepreneurship and business over self-development and tinkering. These changes are also reflected in the definitions and translations of *chuangke*. Fascinatingly, the governmental initiative did not replace one type of spaces with another even if it pushed towards more entrepreneurial and educational profit-oriented types of makerspaces. The maker concept is appropriated and adapted to the Chinese context in multifaceted ways. Indeed, this dynamic diversified the typology by creating hybrid spaces and challenged the already existing ones. At the same time, each city interprets the national initiative in its own way, dealing with an ephemeral and marginal culture. Shanghai has remained hobbyist, while Shenzhen has expanded, and transformed the original hobbyist maker culture into a hybrid borderless platformised entrepreneurship, changing the narrative of the city nationally and globally. Top-down and bottom-up dynamics are complex, and makerspaces are at the crossroads of these grassroots and governmental tensions. New opportunities are created in these fourth places of making.

Makers are given multiple roles, they are not only thought of as fulfilling the ideology of the urban China Dream (Taylor, 2015) but also participating in the growing sharing economy (Lan, Ma, Zhu, Mangalagiu, & Thornton, 2017), and the platformisation of the Chinese society (de Kloet, Poell, Zeng, & Chow, 2019). Despite having been considered as revolutionaries, elite or elitists, instrumentalised by the government or companies, makers—who do not describe themselves as such—are, on a human scale, change-makers. They do not fulfil agendas of saving or changing an economy, but allow individuals to gain new skills, change lifepaths and rethink ways of working and living. Makerspaces are liminal. The urban settings are the ground for projects to start, while the Internet is the key to learn, exchange, and find partners or supporters. As China is moving towards becoming an innovative power, especially in the realm of digital technologies, cities are experimenting with innovative initiatives and platformisation tools. Makers are innovators who are part of marginal, ephemeral, and liminal maker communities adapting to their environment. They play the game of defining or re-defining what makers are and do.

The Chinese maker *chuangke* has an imprint on global maker projects linking makerspaces beyond places and borders. Cities are enablers of makerspaces and maker communities; they are not limiting them. As the maker culture seems to fade in China, the marginal culture sparkles with small-scale impact through projects across the world. Makerspaces represent an opportunity for ambitious and well-connected individuals and are perceived by some as blueprints for the future. Wang's (2016) definition is even more deeply experienced in projects such as Designed in Ethiopia and Kabakoo Academies with the need to transform countries' society and economy. These projects target, and are accessible to, motivated and proactive individuals, namely innovators, offering new opportunities to grow. As discussed in this article, makers are rather marginal for their rarity but directly impact personal lives, and indirectly the Chinese urban narratives, and the perception of China to shift their image from a world manufacturer with the label 'made in China,' to a nation of innovation with the motto 'designed and created in China.' This research gives a voice to makers in urban China, from behind the 'social constructions of innovations' (Pel & Kemp, 2020), embarked on a journey negotiating their narratives and opportunities between top-down and bottom-up dynamics.

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Conflict of Interests

The author declares no conflict of interests.

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Article

Smart Villagers as Actors of Digital Social Innovation in Rural Areas

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Abstract
Digital social innovation (DSI) is commonly associated with cities. However, DSI is not limited to urban space. In rural areas, it is the inhabitants themselves who start and push digitalization projects, and collaborate with professional actors from the outside. These innovators see digitalization as a chance to solve rural problems such as scarce mobility, declining community interactions, demographic change, or urban-rural digital divide. In consequence, DSI such as smart community centers, digitally managed car-sharing, or community apps also emerge in rural areas. The article seeks to better understand the different actors responsible for the rural digitalization processes. Based on interviews, document analyses, and field notes, the article focuses on two cases in rural Germany: Wesedun is part of a regional digitalization project empowering villagers to evolve own ideas, and Wokisrab shows off a bottom-up driven digitalization strategy. Both villages are aiming to improve the quality of life. Indicated by these cases and inspired by literature on social innovation, the actor groups are identified as drivers, supporters, and users. Based on the interactions and collaborations of these groups, we introduce Smart Villagers, the bottom-up actors of rural DSI. In order to design governance processes, the results indicate that even though Smart Villagers are motivated, skilled and engaged, they want and need the support of professional actors from the outside.

Keywords
community building; digital social innovation; digitalization; elderly; ICT; rural areas; village development

Issue
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1. Introduction

Digital social innovation (DSI) is usually considered "particularly active in cities [and] has taken off most successfully in urban areas" (Stokes, Baeck, & Baker, 2017, p. 33). However, we observe numerous digital initiatives in rural areas which also fit the definition of DSI. The manifold challenges of rural areas in Europe range from demographic change (e.g., Christmann, 2017), and service provision (e.g., BBSR, 2018), to urban-rural digital divide (e.g., Salemink, Strijker, & Bosworth, 2017; Townsend, Wallace, & Fairhurst, 2015). DSI in rural areas represent a specific type of social innovations, manifested as new ideas, ways, and practices to meet common goals (Mumford, 2002), that cope with these challenges using digital technologies as tools or digital ecosystems (Bria, 2015; Sept, 2020). Digital initiatives in rural areas provide a broad perspective on how DSI develop in rural areas and what actors are involved in the process of making their villages more liveable places. In the literature, digital social innovators are mainly described in a very general way, focusing on the fact that "innovators, users and communities collaborate" (Bria, 2015, p. 9), the forms and technical means of collaboration (e.g., van Dijck, Poell, & Waal, 2018) or looking at specific phenomena such as fab labs (e.g., Diez, 2012; Fleischmann, Hielscher, & Merritt, 2015) or crowdsourcing (e.g., Aitamurto, 2012; Certomà, Corsini, & Rizzi, 2015). While initial studies fo-

cus on the driving actors in rural DSI (e.g., Sept, 2020) or analyze smart citizen participation in cities (e.g., Capra, 2016; Cardullo & Kitchin, 2019), the characteristics and roles of the broader field of actors involved in DSI in rural areas have hardly been addressed in existing literature, even though the knowledge of actors in rural DSI will be beneficial for designing governance processes and support. An actor-oriented approach is required regarding social innovation in rural areas, "as such a perspective better allows the analysis of the self-organising practices of actors involved in rural development" (Neumeier, 2017, p. 43). Therefore, we seek to better understand the individual actors who take on the responsibility for the digitalization processes of their villages. Our question is: Who are these digital social innovators in rural areas, and which roles and characteristics can we attribute to them?

As we are especially interested in rural areas, we focus on two German villages, Wesedun in North Rhine-Westphalia and Wokisrab in Brandenburg which are particularly recognized for their digital initiatives.

This article continues with a literature review developing a perspective on characteristics of actors of social innovation in rural areas and connects these debates to literature on DSI (Section 2). Afterwards, we present the DSI initiatives in the two villages (Section 3). This is followed by an analysis of the actors' roles in the DSI. Based on these findings, we introduce the notion Smart Villagers as central actors in rural DSI and elaborate their characteristics (Section 4). Finally, we conclude with some considerations on how our insights might be used for other rural DSI, emphasizing also the limitations of our research (Section 5).

2. Social and DSI in Rural Areas

DSI is defined as:

> A type of social and collaborative innovation in which 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. (Bria, 2015, p. 9)

In Europe, the idea of DSI has been promoted and introduced into policy and research debates by the DSI4EU project, funded by the European Commission (Stokes et al., 2017). In their mapping, the authors mentioned over 1,000 DSI projects, most of them in Western and Southern European cities (Stokes et al., 2017, p. 33), while, "the application and usability of ICT in the context of a village remained underdiscussed in the literature" (Visvizi & Lytras, 2018, p. 1). Although European approaches on smart villages refer to social innovation and digital technologies, these remain "two rather separate discourses" (Slee, 2019, p. 635), and, apart from policy papers, DSI is hardly discussed for rural areas (Sept, 2020). Nonetheless, it has long been shown that broadband access contributes to sustainability of rural life (e.g., Townsend et al., 2015), and we can observe that villages use new technological possibilities, combining the innovations of digital technology with new social practices. Respectively, it is also possible that the apparently high concentration of DSI in cities is due to rural areas receiving less attention from researchers, a phenomenon that has long been known as urban bias (Lipton, 1977). Regarding company-level innovation, for instance, Shearmur noticed an "inherent urban bias to innovation studies" (Shearmur, 2017, p. 452), although innovations outside agglomerations receive more and more attention (Eder, 2019).

For studying DSI actors in rural areas, we therefore rely on research insights to social innovation. The amount of research on social innovation in urban and regional development (Nyseth & Hamdouch, 2019) has been growing since the 1990s with increasing numbers of studies since 2003 (Howaldt & Schwarz, 2019; van der Have & Rubalcaba, 2016). Although the vast literature on social innovation shows "a variety of conceptual approaches" (Christmann, 2020, p. 425), Mumford's definition of social innovation as "the generation and implementation of new ideas about how people should organize interpersonal activities, or societal interactions, to meet one or more common goals" (Mumford, 2002, p. 253) received particular attention (Christmann, Ibert, Jessen, & Walther, 2020, p. 499). We refer to this definition because it distinguishes social innovation from other types of innovation but acknowledges that innovations may have social, technological and economic aspects and can happen on all territorial levels.

Recently, social innovation in European rural areas has gained attention (e.g., Bock, 2016; Christmann, 2017; Fink, Lang, & Richter, 2017; Noack & Federwisch, 2019; Richter, 2016). Rural social innovations are frequently characterized by the fact that they are not perceived as such by the local actors themselves but are presented as solutions to existing problems (Christmann, 2019, p. 236). Rural areas have always been used as experimental spaces; often, it was artists or alternatives who came to the countryside to try something new (Christmann, 2019, p. 236). Accordingly, many works focus on the initial impetus for social innovation in rural areas being external factors (e.g., Butkeviciene, 2009; Neumeier, 2012). For example, in his "proposal for a stronger focus on social Innovations in rural development research," Neumeier assumed that "it is likely that the initial impetus for innovation is triggered by external factors, as ideas or the identification of a need to change one's behavior very seldom arise in a vacuum, without any external influence or stimulation" (Neumeier, 2012, p. 63). Studies on rural social innovation based on "concepts of neo-endogenous development also acknowledge that…for certain aspects external knowledge and resources will be required" (Bosworth et al., 2016, p. 443). Noack and Federwisch empirically "examined

the role of external factors and cross-border constellations of actors" (Noack & Federwisch, 2019, p. 106) in rural social innovation initiatives, showing that rural innovation initiatives are likely to "draw on urban knowledge and practices" (Noack & Federwisch, 2019, p. 106). Furthermore, studies focus on specific actors, for example social enterprises (e.g., Richter, 2017; Richter, Fink, Lang, & Maresch, 2020), or the process of successful social innovation (e.g., Bock, 2016; Bosworth et al., 2016; Neumeier, 2017). Meanwhile, empirical knowledge of the different roles, actors are embodying, in the process of rural social innovation, is still scarce (Marini Govigli et al., 2020, p. 3), but, as Neumeier demands, "to understand social innovation in rural development fully there is a pressing need for more grounded empirical case study research" (Neumeier, 2017, p. 43).

Studies that deal with social innovation in general provide helpful references to different actors and their roles (e.g., Butzin & Terstriep, 2018; Terstriep, Kleverbeck, Deserti, & Rizzo, 2015). Butzin and Terstriep distinguish "developer, promoter, supporter and knowledge provider which come from the public and private sector as well as civil society" (Butzin & Terstriep, 2018, p. 78). According to them, developers initiate and operate the innovation. Promoters are partners that provide equipment, funding or connections to policy programs. Supporters facilitate the diffusion of social innovations and knowledge providers offer specific knowledge relevant to the development process (Butzin & Terstriep, 2018, pp. 78–79). They underline that individual actors are not strictly linked to one role. They may take on several roles or switch between different roles over time. Therefore, the roles are not performed statically but in a dynamic process.

In contrast to these insights from social innovation, actors in DSI are described as "innovators, users and communities [who] collaborate using digital technologies to co-create knowledge and solutions for a wide range of social needs" (Bria, 2015, p. 9). This means that previously separate groups of actors now overlap and co-create knowledge and solutions: Users become producers and the other way around. This is reminiscent of Butzin and Terstriep's idea that actors can change their roles within processes of social innovation. Next to the roles of actors, one must, however, in the case of DSI also consider the role of digital technology:

> Technology which drives collaboration, or is explicitly outward-looking, is at the heart of most DSI. Specifically, of the four most commonly used technology groups, three directly facilitate and rely on collaboration or network effects (Social Media and Social Networks; Crowdsourcing, Crowdmapping, Crowdfunding; Peer-to-Peer Networks). (Stokes et al., 2017, p. 27)

To summarize: Detailed empirical insights into DSI in rural areas are still rare. If we want to better understand rural DSI, we must draw on the discourses on SI in rural areas and urban DSI. This results in two focuses: 1) the actors involved and their roles within DSI initiatives and 2) digital technology and its contribution to cooperation and community-building in villages. In this article, we concentrate on the first, using an actor-centered approach (Neumeier, 2017, p. 43).

3. Digitalization Projects in Two German Villages

3.1. Research Design

The villages Wokisrab and Wesedun belong to the so called structurally weak, rural regions in Germany (BBSR, 2017; BMWi, 2017) where the population is shrinking faster than average (BBSR, 2018). Both villages have less than 1,000 inhabitants and face problems of demographic change, missing or scarce public and private services, and consequently long distances to shopping facilities, workplaces, educational, and cultural opportunities. To guarantee the anonymity of our interlocutors, we use pseudonyms for their names. However, as we were especially interested in some of the actors' characteristics, such as age, gender and profession, these characteristics remain unchanged. To increase anonymity, pseudonyms are also used for the names of the two villages. Both villages have been chosen because they have attracted attention in the media, in policy papers, or during spatial development conferences through particularly innovative, digitally supported projects. Thus, they not only show new practices of collaboratively using digital technologies but are also discursively marked as innovative (see Hutter, Knoblauch, Rammert, & Windeler, 2018, pp. 20–21); and therefore we considered them examples for DSI.

The field work in the villages was carried out between July 2019 and February 2020. Inspired by the ideas of a focused ethnography (Knoblauch, 2005), we combined semi-structured expert and digital-biographic interviews with document analysis and participant observations. In Wokisrab 13, and in Wesedun 15 interviews have been conducted, transcribed, and analyzed. 33 documents complemented the data. Furthermore, we conducted participant observations during local digitalization courses and special events (such as a summer festival, the formal delivery of a shared village car, or networking events). We took a 'field-observer role' (Knoblauch, 2005) during our observations, with a focused approach over several short-term field visits, instead of long-term visits.

3.2. Wokisrab: Building Up Community

Wokisrab is located in the federal state of Brandenburg, around 80 km from Berlin city center. 183 inhabitants live in Wokisrab, around 20 of them are children and teens under 18. The village is a typical, one-street village with a traditionally agriculture-based economy. During

GDR times, a large-scale agricultural cooperative was the main employer. Today, only a few inhabitants live on agriculture. The only village store and pub had closed during the 1990s. The closest supermarkets and a train stop are 8 km away. Bus service runs irregularly four times a day on weekdays. Mobile telephone and Internet connection are weak all over the village. Cable broadband connection is comparable to urban areas in Germany at 50 MBit/s (Bundesnetzagentur, 2020).

We perceive the community of Wokisrab in a process of rebuilding after suffering the losses of infrastructure, employment and population since the end of the GDR. According to the villagers, the spirit of community was completely lost during the 1990s: Inhabitants mostly concentrated on their own private lives. The village has been described as a sad and messy place where "everybody is on bad terms with everybody and nobody [can] get anything going" (D1_I04). The first step towards reuniting as a community was initiated by a newly elected village head in 2008. After retirement, she moved to Wokisrab, founded the Village Association, and successfully established a small village newspaper to foster communication and information. A local graphic designer, Daniela Motz, voluntarily took over the responsibility for composition and layout of the newspaper. Another villager, who was professionally engaged with control systems, started building a village website providing historic information and announcing current developments and events: "There are no meeting points anymore. But the small newspaper gives the possibility to spread information. And of course, the same is [true] for the homepage" (D1_I03).

Another step was initiated by Barbara Groß and Werner Titz, a couple who also moved to Wokisrab after their retirement. They bought the vacant former village store and reopened it as a multi-use space. Since 2018, twice a week, the place is used as café, bar, and meeting place, and special events take place irregularly. Additionally, it also serves as the first and only public WiFi Hotspot in the village. Recognizing that a public WiFi Hotspot is useful and necessary marked the start of integrating digital technologies for the improvement of village life. Since the mobile network is unreliable, especially people temporarily living and working in Wokisrab, visitors and kids benefit from the hotspot.

In 2016, Werner Titz became the new head of Wokisrab, and Barbara Groß the chair of the Village Association. According to several villagers, their engagement is the reason why the village community restarted. Their new activism also led the village to enter a village development competition in 2017. Birgit Zuse, a staff member of the district administration, had noticed the new activism in Wokisrab and proposed that the village participates in the competition. A group of around 15 inhabitants, including Werner Titz and the Village Association, started to think about a possible future for the village and put together an application based on some existing village projects. These projects were mainly analogue, such as a bee pasture, an insect hotel, or a table tennis table. The village application won the competition on district level and qualified for the next round on state level. Overwhelmed by their success, the group developed a new village strategy focusing on chances of digitalization to deal with current problems such as mobility and community building. They began to "really think long term, where do we want to see our village in the future….And that's how we realized that it is important to take the villagers and the village with them into the digital age" (D1_I01). By preparing the competition, the group created new ideas on how to use digitalization to develop the village.

The village community came up with four main ideas. One of them was a shared village e-car, a village internal car-sharing program using a digitally managed calendar and administration system. Two other ideas were proposed by a young engineer, Gerd Neumann: A digital communication platform and a shared village database of photos and documents. In order to establish basic communication skills, a digitalization course was planned, too. In the Brandenburg-wide village competition, Wokisrab won a special award for their strategy to deal with challenges of the digital change. As an additional prize, the district administration, again driven by Birgit Zuse, offered a digitalization course, executed by the district's adult education center, directly in the former village store. Content of the course has been decided collectively by the participants.

In 2019, the district administration invited tenders for alternative mobility, and the Village Association of Wokisrab received funding for buying an e-car. Gerd Neumann took over the responsibility to find the right application to manage the village e-car. After researching commercially available apps for car-sharing via the Internet and by recommendation of other villages, he invited three firms for tenders. Decision criteria included the price and usability for users as well as administrators. Two days before the official inauguration of the village car, the application was presented and explained within the digitalization course. In February 2020, the village car arrived in Wokisrab and is now in use.

3.3. Wesedun: Organized and Self-Confident

Wesedun is located in the federal state of North Rhine-Westphalia. 780 inhabitants currently live in Wesedun, with 50 people being employed within the village. 65 inhabitants are between 14–18 years. Since Wesedun has no thoroughfare and is surrounded by a wooded mountain range and a big river, its economy has traditionally been based on tourism and flower farming. Local tourist attractions include a castle with garden, a long-distance cycle track and a yaw-rope passenger ferry. It is a 5 km drive to the core city, Bachingen, where basic supplies, education and work are available.

Over 10 years ago, there was an adequate infrastructure in Wesedun including a butcher's shop, post office,

hairdresser, bank office, school, supermarket, bars, and restaurants. Today, only the kindergarten, bakery, two guesthouses, three bus stops, and a train station are still present. The train is an unusual advantage. Every hour a train leaves Wesedun towards a university city. The quality of the digital infrastructure is described as inconsistent:

> The WiFi speed is brilliant. This was also our reason to start a project on digitalization. We have 100 Mbit/s everywhere in Wesedun. But this is just since 2017. The mobile reception is highly fragmentary, with every provider you have reception but on different spots in the village. None is village-wide. That means for tourists arriving at the riverside, if they have the wrong provider, they are unlucky. (D3_I01)

We describe the community of Wesedun as organized volunteers. There is a long tradition of local clubs and structured volunteer engagement in the community. The Club Association represents a broad variety of clubs such as the Catholic Women's Union or the Sports Union. There are also other organized groups such as a flower and a hiking group. The volunteers focusing on village development are called 'Village Workshop.' Some inhabitants volunteer on several positions. A lot of this engagement is managed by Gerald Richter. He is the local conservatist, the chair of the Club Association and of the Village Workshop. He has a large influence on the community and takes this responsibility quite seriously and professionally. One interviewee said that the impression of Wesedun is mainly shaped by Gerald Richter and his competent and enthusiastic nature to motivate people (D3_I06). Another one said: "Mr Richter? He is the engine of the whole story. For years he has been the managing director of the district's IT department. Therefore, he has good knowledge but also good contacts. That makes a huge difference" (D3_I09). Generally, the community is described as harmonious and sincere, "incredibly well organized" (D3_I02) or "professional, digital and proud" (D3_I02).

In 2017, the municipal mayor of Bachingen announced the invitation for proposal for the Digital Countryside (DC) project. Since Wesedun had just recently received an upgrade of their Internet connection, he especially directed this information towards the elected head of Wesedun, who passed it to the Village Workshop (D3_I01).

DC took place in two districts during 2016–2019. The program is financed by the EU and the state. Heike Wittig described the aim of DC as to bring:

> The benefits of digitalization into the rural areas. This region we are in is especially rural. That means, the villages especially struggle with demographic change, ageing of society, migration flow towards the cities and many villages are definitely isolated in terms of mobility. Banks, restaurants and shops are closed and the interaction between people is not happening on the garden fences anymore since many inhabitants are forced to commute for labor….Therefore, the goal of DC is to use digitalization for new possibilities to make the rural areas fit for the future. (D3_I02)

15 villages were accepted after they applied with their own ideas. Most ideas concerned the improvement of communication and information. For Wesedun, DC was managed by the Economic Development Corporation of the District with Heike Wittig as the project manager. She advised the villages throughout the process, organized network events, and provided contact and information about service providers and technical solutions.

The Village Workshop in Wesedun had already formulated a development strategy called 'Actionplan Wesedun 2020' with the goal to meet the challenges of demographic change. But besides improving the village website, no digital topic had been part of the development strategy. With the upgraded Internet connection and the call of DC, the group started to ideate about the possibilities of digitalization for the village community. Gerald Richter "put his heart and soul" (D3_I03) into specifying the best nine ideas and authoring the application for DC.

Wesedun realized five of their ideas within the funding period. The ideas were divided into two sections: 'demography,' with the highest priority, and 'digital infrastructure.' In order to meet the challenges of demographic change, the focus was to improve the quality of life, mobility, social integration, and autonomy of elderly villagers. Gerald Richter mentioned that:

> Especially the demographic change in the village has been the reason for founding the Village Workshop. We wanted to set something against this process and save the quality of life within the village. This was the reason for our digital project. With our application at DC we got the financial support that we needed to realize a project, now we had to think about a digital solution. Without DC the project would most likely not have been digital. (D3_I01)

Subsequently the villagers invented a digital village emergency call application which was programmed and implemented in collaboration with a small tech start-up. With the new application, solitary elderly villagers can get help from other villagers if they find themselves in a non-medical urgent situation. Just by pushing a button on the smartphone, registered volunteers get a notification where help is needed.

Furthermore, Internet courses for the elderly were planned, because "it is not that they cannot understand, it is that they need support by doing their first digital steps" (D3_I01), said Gerald Richter. Eight villagers were trained for 18 months at the adult education center to subsequently give Internet courses to fellow villagers over the age of 65. In addition to the training of

these 'village's digital experts,' Wesedun was equipped with hardware for offering Internet courses. The village's Internet courses are regularly fully booked, with additional requests from neighboring villages. The third measure for the 'demography' section is a community application programmed and developed by an applied research institute based on the needs and demands of the villagers. With the application, villagers can share news and information, offer and ask for items and neighborhood assistance. One user said:

> The village application is like Facebook for the village. We still speak in direct contact with each other but information is better shared over the app….I also picked up two, three things which were offered in the 'search & offer' section. (D3_I15)

In the section of 'digital infrastructure,' the community building was equipped with smart home technology and WiFi by a specifically interested and skilled member of the Village Workshop. The technology is supposed to make the building safer and more comfortable, while giving the villagers insight on smart home technology.

4. Drivers, Supporters and Users: Smart Villagers in DSI

In both villages, different types of actors are involved in the process of DSI. On a vertical level, they can be differentiated by top-down actors (professionals from outside of the village) and bottom-up actors (volunteers, belonging to the village). On a horizontal level, inspired by the argumentation in the literature (Bria, 2015; Butzin & Terstriep, 2018), we can identify three groups of actors: 1) drivers, 2) supporters and 3) users. They are defined based on their specific interest, knowledge, level of engagement and connection to the village. The groups are linked to each other and interact in different stages of the process. Furthermore, actors are not tied to one group: They switch between roles or are part of several groups. For example, users can act as supporters, when testing the new technology. Or drivers that use their own innovations are simultaneously important users. The following analysis of the actor groups will lead to the definition of Smart Villagers in Section 4.4.

4.1. Drivers

Inspired by the actor groups 'developer,' 'knowledge provider' and 'supporter' (Butzin & Terstriep, 2018), we defined the 'drivers' as actors who initiate, operate, represent, and manage the innovation and the other actors in every stage of the process. They are technology-friendly and enthusiastic about or at least open to digitalization. They are aware of regional problems and push to change the situation. They encourage and motivate the users and supporters. Drivers take gratification from feeling self-efficient in their engagement, raising public awareness, being taken seriously, and having their successful improvements visible. They are either formally organized volunteers within the village (bottom-up) or professionals outside of the village (top-down).

'Bottom-up drivers' are often retired or new village inhabitants. These actors tend to be voluntarily active people that take on responsibilities. Some even involve themselves with the village administration, a voluntary and unpaid task, in both villages. These characteristics are typical also for general volunteer involvement in villages (Laschewski, Steinführer, Mölders, & Siebert, 2019, p. 35) and social innovation in rural areas (Noack, 2017; Noack & Federwisch, 2019). The drivers come up with new ideas, motivate, and manage other volunteers, look out for funding opportunities, write applications, organize the local meeting room, do networking, and represent the DSI in the media, on the municipal and at the district level. Each driver offers specific knowledge or experience useful for the DSI, which is often related to their (former) employment. One interviewee stated:

> We are really lucky that some villagers have professional experience on important topics. When someone works for the district government, they know how to address public funding and support. Or the former regional IT manager takes on the position as the village conservationist. But there are also people moving to the village and bringing ideas and input from the outside. (D3_I04)

New inhabitants like Barbara Groß and Werner Titz can play a particular motivating role, as Daniela Motz describes: "We took courage that such a small place like Wokisrab can really have a say….I think if Barbara and Werner hadn't come, nobody would have ever thought of taking part in such a competition." (D1_I06).

A strong dependence on individual actors can pose a risk as individuals may suffer burn-out or illness and thus activities could be halted. This risk is also acknowledged by local drivers like Gerd Neumann "to avoid that then suddenly one person falls away and nothing more happens, I am always in favor of spreading everything over many shoulders" (D1_I10). Indeed, surrounding the main drivers, we find working groups of about 10–20 villagers, be it the Village Workshop or the Village Association. Members contribute with their experience in brainstorming for new ideas, project applications, teaching, programming, installing or managing technology becoming drivers, too. Under the lens of citizen power, we can describe the drivers as leaders, decision makers and co-creators (Cardullo & Kitchin, 2019, p. 5).

'Top-down drivers' are often professionals, who operate on district level. The Economic Development Corporation of the District, for example, conceptualized DC, applied for funding and gave the initial impulse for ideating on village level. Heike Wittig, as well as Birgit Zuse, give advice and regular impetus to the villages, monitor the process, or mediate between the villagers and the service providers. With regard to Birgit Zuse,

Barbara Groß describes that "the district keeps us going…and plays a significant role" (D1_I01).

4.2. Supporters

The actor group of 'supporters' offers specific knowledge, funding, connections to policy programs and service providers, or other kinds of active engagement requested by the drivers. In contrast to Butzin and Terstriep's (2018) 'supporters,' who mainly facilitate the diffusion of the innovation, our supporters are also to some extent 'promoters' and 'knowledge providers.' They use their experience to advise the drivers as well as other villages about DSI and report their news, thus actively support the diffusion. They enter the process when their support is required but do not actively develop new ideas. Similar to the drivers, 'bottom-up supporters' within the village are volunteers, while 'top-down supporters' outside of the village are mainly professionals. They can also be distinguished by their level of activity: Supporters "partially re-arrange the deckchairs on a ship's deck, but not to determine how the ship is run or its general course" (Cardullo & Kitchin, 2019, p. 8).

Supporters develop or administrate apps, do layout, advise, correct texts, or give Internet training. Their support activities are often based on, connected to, or part of their professional work, like the engineer Gerd Neumann, who takes responsibility for the car-sharing application. Another example is Hilde Schneider, a temporary inhabitant in Wokisrab, who is working as an editor and supported the application for the car-sharing funding: "That's where I went in and basically did a lot with the formulation of all the documents, I also took up my work as an editor and formulated everything a bit more professionally" (D1_I13). Thus, while research on rural social innovation suggests focusing on driving actors and external impetus, we find that specific local skills are strongly needed to support the drivers.

From the outside, there are also less active supporters, such as political and administrative actors that provide advice and information on measures and funding opportunities, motivate the village to continue, represent the DSI in the public, and provide a network or knowledge about political and strategic planning. It is again often the district level acting as supporter. For example, in Wokisrab, the deputy district administrator explained that "support is now provided by computer courses which are organized by the district adult education center. The costs of this project are also covered by the district, to support this pilot project" (D1_I05). While Birgit Zuse is considered a driver, the district administrator and the deputy are described as "not in the front line, but when certain things are said, they are very, very open" (D1_I01) and are, therefore, supporters.

Other important supporters are the tech organizations that collaborate with the villagers to program and develop customized digital technology solutions and content, like the institute for applied research and the tech start-up. A local journalist who reports about village activities also counts as supporter as well as the public financiers like the EU or the adult education center that trained the 'villager's digital experts' in Wesedun.

4.3. Users

In line with the definition of DSI (see Section 2), we identified 'users' as an important, yet unnoticed group in rural social innovation. Users not only collaborate with but also motivate drivers and supporters. Hilde Schneider, who supported the funding application, was also an early user of the village WiFi, for her the opening of the former village store "was a great leap in quality, because a WiFi connection was set up" (D1_I13). Users like her are a motivating force. Werner Titz proudly describes her sitting in front of the store: "She lives in the castle and has no WiFi there, she sits here. So, WiFi was the first step. And then we said, now we have to see that we lead people [to broader digitalization]" (D1_I02). Thus, without the users, the DSI would not be successful. Users are part of the village community. Their level of engagement can vary over time. Depending on measures, they can passively use the DSI or actively create interactions. For example, a user can be an active student in the Internet courses while just being a quiet reader on the village application, until eventually posting some news. Besides having personal motives to use the measures, e.g., online banking or online photo books (D3_I12), they perceive the improved community communication as the most important gain: "Meanwhile I know almost 2/3 of the local villagers, many of them I did not know before. I really appreciate that and it is also part of what I understand as 'home"' (D3_I08).

Users benefit from using the public village WiFi. They book the village e-car via the application. They communicate through the village application and help the elderly via an emergency application. They learn in the Internet courses and make use of the smart home community hall.

4.4. Smart Villagers

As a result of the above described and defined groups of actors, the actively involved actors of all three groups who are residents or have their secondary residence in the village, can be defined as Smart Villagers (see Figure 1). Smart Villagers are visible members of the village community, therefore, on the vertical level, they are bottom-up actors. They are somehow skilled, be it technical, organizational or communicative skills, and they develop additional competences throughout the innovation process. No matter if they belong to the drivers, the supporters, or the users, they share a positive and interested attitude towards digitalization. They are aware of the rural issues and are open to innovative solutions. Hence, they actively use and develop DSI to shape and improve everyday village life. Smart Villagers are self-

confident about the benefits of their DSI. They do not want to rely on governmental strategies but try to canvass public funding. Through their engagement, they strengthen the community spirit and take gratification from being perceived as a future-oriented and inspiring village. Smart Villagers are the carriers of the digital social change in rural areas. They push forward and motivate others to engage and thus become Smart Villagers, too. To sum up: Smart Villagers can be characterized with their digital positivity, problem awareness, active engagement, motivation, community orientation, responsibility and self-efficiency. On horizontal level, they can be found in all three groups of actors. In the "scaffold of smart citizen participation" (Cardullo & Kitchin, 2019, p. 5), their form and level of participation correspond to 'citizen power' and 'tokenism': They are inclusive, bottom-up, collective autonomous and experimental.

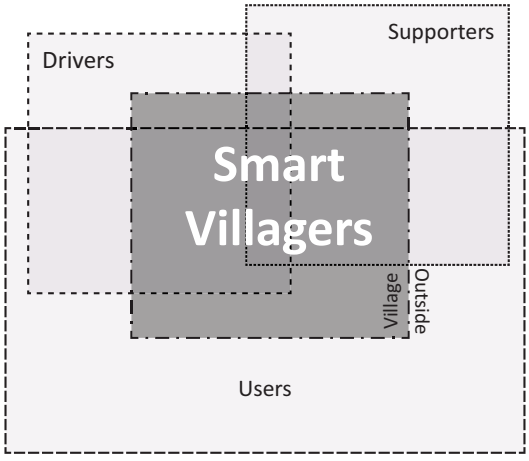

Figure 1. Smart Villagers in rural DSI.

5. Conclusion

DSI are a way to cope with typical rural challenges such as demographic change (e.g., Christmann, 2017), service provision (e.g., BBSR, 2018) or urban-rural digital divide (e.g., Salemink et al., 2017; Townsend et al., 2015). The study presented is a step to better understand the rural innovation process. The notion of Smart Villagers introduced here provides insights that can be used to design governance and support strategies in rural development. Aiming to better understand the self-organizing practices in rural DSI, we followed Neumeier's (2017) suggestion to use an actor-oriented approach, and chose focused ethnography to gather data in two case studies.

The specific aim of this article was to understand who the digital social innovators in rural areas are, which roles they have, and which characteristics can be attributed to them. Inspired by the literature on social innovation (Butzin & Terstriep, 2018), citizen participation in smart cities (Cardullo & Kitchin, 2019) and DSI (Bria, 2015) we identified three actor groups in our case studies: driver, supporter and user. Our contribution to the scientific discourse is therefore, combining an actor-centered approach on rural innovation with actor perspectives from literature on social innovation and confronting these with empirical data from DSI in rural villages.

As the main result, we condensed our findings and introduced the notion Smart Villagers for the actively involved, bottom-up actors of all three groups. They appear as the core of rural DSI. In both cases we identified a group of 10 to 20 people being the constantly active Smart Villagers. They all bring specific skills and a technology-friendly attitude into the process. As for other social innovations in rural areas (Noack, 2017; Noack & Federwisch, 2019), we can observe retired, elderly people being especially active Smart Villagers.

Like other research on DSI (Bria, 2015; Stokes et al., 2017), we noticed that the observed villages make use of technology to support and encourage collaboration or community building. Digital technology is used to solve concrete problems. Next to mobility and communication, the needs of elderly villagers were primary fields of application. However, the innovative core is mainly not the digital technology as such or the collaborative technological development but the collaborative way of using and implementing it in the villages.

Rural DSI may be developed by Smart Villagers in a bottom-up process with outside support as in the case of Wokisrab or manifest as a top-down–bottom-up interplay as in Wesedun. We see both ways as promising DSI paths and consider the district level—next to the local one—as fundamental. Professional actors on this level support and motivate Smart Villagers and can offer stability. Or as one interviewee said "volunteers need the assistance of full-time professionals" (D3_I06). However, we can also confirm for rural DSI what Neumeier assumed for social innovation: "Processes initiated by the actors themselves, as well as a framework enabling the actors to develop social innovation processes seem to be more promising than purely externally governed processes" (Neumeier, 2017, p. 39). This means that Smart Villagers with their equally important roles, from drivers to users, must be acknowledged and supported from outside the village.

The explanatory power of this article is limited. We are not able to foresee the further development of the DSI or their long-term impact. A key open question is whether the drivers, who are mainly responsible for the DSI, will manage to maintain their high level of commitment over a long period. In the case that one of the drivers happen to disengage, we are unsure about the consequences for the DSI and the community. To answer these open questions, we plan to revisit the villages by the end of 2020. Another limitation is due to the geographical focus on two German cases; DSI in other European rural areas might significantly differ.

Further research on the long-term effects of DSI in village communities would supplement the results presented and add to the slowly growing field of DSI research. Moreover, a closer look at how the 'social' meets the 'digital' in the case of rural DSI warrants further re-

search. Additional results in this field can inspire public policy and governance strategies, future Smart Villagers and technology oriented social entrepreneurs.

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Conflict of Interests

The authors declare no conflict of interests.

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Article

Challenges of Urban Living Labs towards the Future of Local Innovation

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Abstract
Finding new approaches to overcome complex urban problems such as climate change has always been of interest to policymakers and academics. The changing dynamics of urban development result in the diversification of new practices during which experimentation is used to inform urban practice. Amongst these approaches, urban living labs (ULLs) have become a popular form of urban experimental innovation in many countries in the last decade. These ULLs respond to the increased complexity of future challenges calling for local solutions that acknowledge the local conditions—political, technical, and social. Even though a great deal of attention has been given to this form of urban innovation, there has been little consideration of the learning and innovation processes within ULLs. Based on a comparative case study of three innovation projects in a ULL in the city of Amsterdam, we analyse and discuss the claims of ULLs regarding innovation and the different orders of learning they foster. We argue that in the processes of experimentation within ULLs, combining mechanisms of learning and innovation is key to promoting the development of particular local solutions. However, since the learning processes are especially concerned within a particular ULL learning setting, there is a mismatch between the expectations of policymakers, industry, citizens, and knowledge institutes, as well as how the lessons learned can be useful for other contexts.

Keywords
Amsterdam; future challenges; learning; local innovation; urban living labs

Issue
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1. Introduction

There is a growing recognition that cities face complex environmental problems and require multiple and interdisciplinary approaches to overcome their unprecedented challenges. Urban Living Labs (ULLs) are defined as:

> A forum for innovation, applied to the development of new products, systems, services, and processes, employing working methods to integrate people into the entire development process as users and co-creators, to explore, examine, experiment, test and evaluate new ideas, scenarios, processes, systems, concepts and creative solutions in complex and real contexts. (JPI Urban Europe, 2013, p. 1)

They aim to overcome important and persistent barriers to implementation and adoption (Franz, Tausz, & Thiel, 2015), such as the lack of user commitment and the mismatch between policies and innovations and the specific, local physical and institutional environment (Araos et al., 2016; van Bueren & De Jong, 2007). They provide a co-creative environment, in which multiple stakeholders test, develop, and create solutions to the contemporary challenges of cities. Given the complexity of the urban challenges we face today, ULLs provides an essential platform to create a connection between fundamental research and societal impact by connecting the different disciplines and stakeholders.

It has been argued that the creation of such platforms has a potential to provide an alternative space

that can facilitate a new ecosystem, interaction, and enable more experimentation (Concilio & Molinari, 2014; Pereira, Karpouzoglou, Doshi, & Frantzeskaki, 2015). A more open and transparent way of collaborating can open up change and dialogue between academics, practitioners, and stakeholders from different backgrounds. This not only strengthens the debates between the social sciences and other disciplines but also offers better insights for global environmental change as well as global governance and stewardship (Stone-Jovicich, 2015). While an increasing number of social and environmental challenges require the involvement of actors from different organisations, this interaction stimulates the involvement of non-scientific actors in the context of alternative modes of knowledge production. This is especially crucial as traditional forms of knowledge creation, i.e., disciplinary and primarily cognitive, has been limited and does not capture the broader interdisciplinary social and economic context (Gibbons et al., 1994). New forms of expertise and knowledge are needed to contribute to the societal and environmental problems faced by cities today (Ersoy, 2017; Jasanoff, 2004; Nowotny, Scott, Gibbons, & Scott, 2001).

ULLs can be placed within the changing dynamics of urban challenges during which experimentation is used to inform urban practice. As part of this process, they adopt participation as key towards achieving their goals of addressing urban sustainability challenges (Juujärvi & Pesso, 2013; Menny, Palgan, & McCormick, 2018; Voytenko, McCormick, Evans, & Schliwa, 2016). Participants help design and develop innovations, and test new ways of addressing sustainability challenges (Bulkeley et al., 2016; Nyström, Leminen, Westerlund, & Kortelainen, 2014) through an iterative process of feedback loops that involve the design, construction, and use of instruments (Karvonen & van Heur, 2014). However, since the actors involved in ULLs, understandably, are especially interested in the local outcomes, the articulation of knowledge and learning within ULLs is often absent or lacking (Franz et al., 2015; Schuurman, Baccarne, Marez, Veeckman, & Ballon, 2016). The production of such formalized knowledge, needed for the replication or upscaling of innovations, is often not a priority for the actors involved. Their attention is often focused on the substantive results, with the achievements being communicated in terms of measurable, successful products and local improvements. Moreover, ULLs have been adopted without much reflection on whether or not they actually achieved their goals. Understanding the multiple dynamics within these active environments is essential as they are the results of complex actions, the socio-spatial system of resources, actors, context issues, and the governance system (Concilio & Molinari, 2014).

In our article, we explore how learning processes can be conceptualised as part of the innovation processes of ULLs. Based on a comparative case study of three innovation projects within a ULL in the city of Amsterdam, we analyse and discuss the claims of ULLs regarding the learning and innovation taking place. Our cases show that there is an inherent tension between the development of innovations to be adopted elsewhere, by others, and the development of innovations that work in the particular context in which they have been developed. We argue that the process of experimentation allows different orders of learning in ULLs. In such processes, combining mechanisms of learning and innovation is key to promoting the development of particular local solutions.

2. Open Innovation and Learning within ULLs

With an increasing awareness that the traditional model of innovation is becoming obsolete, a new paradigm of 'open innovation' has emerged connecting internal and external sources of information-rich environments (Chesbrough, 2003). Open innovation pays attention to improving organisational construction and strategic maintenance as well as enhancing the competitive advantage of firms. Stemming from open innovation, a series of new concepts has been coined to refer to the increasing importance of knowledge creation. While the 'Triple Helix' of university–government–industry relations focuses on the knowledge infrastructure of innovations provided by such relations, it brings new ideas in relation to organized knowledge production in a knowledge-based economy (Leydesdorff, 2006). With the rise of open and user-centric innovation policy, a new form of cooperation, Quadruple Helix, has been discussed as part of a broader cooperation in innovation. As part of this form of cooperation, an era of linear, top-down, expert-driven development of service provision is giving way to different forms and levels of coproduction, involving consumers, customers and citizens, as well as public authorities in the provision of public services (Arnkil, Järvensivu, Koski, & Piirainen, 2010; Carayannis & Campbell, 2009). The term coproduction here has been referred to in both management and social sciences literature in a number of different ways. It emphasises dimensions of meaning, discourse, and textuality (Ersoy, 2017) while addressing a number of disciplinary enquiries from political scientists, sociologists, social theorists, and anthropologists (Jasanoff, 2004) to environmental governance and management (Wyborn, 2015). It offers alternative ways of imagining for academics to work with policymakers (Perry & Atherton, 2017; Polk, 2015).

Similarly, learning initially was conceptualised to manage change in organizations (e.g., Hargrove, 2002), but was soon applied to processes of policy change as well (Bennett & Howlett, 1992). Three different kinds of learning process have been conceptualised for people, organisations, and groups in order to modify their actions. Amongst them, single and double-learning loops have been used very widely in the literature. Argyris and Schön (1978) used these terms to correspond to the changes in resource governance regimes based on the theory of action. While single-loop learning has

been said to adapt the behaviour and actions of organisations to mitigate and improve the situation without much reflection on the process, double-loop learning aims to stimulate a deeper understanding of assumptions and the decision-making process. It implies a reflection on goals and problem framing and how goals can be achieved. Triple-loop learning, on the other hand, refers to a transformation of the structural context and factors that determine the frame of reference. Pahl-Wostl (2009, p. 359) argues that "this kind of societal learning refers to transitions of the whole regime (e.g., change in regulatory frameworks, practices in risk management, dominant value structure)." Transforming requires recognition that paradigms and structural constraints impede an effective reframing of resource governance and management practices. It is also possible to conceptualise these loop-learning processes in lower-order and higher-order learning (Brown & Vergragt, 2008; Brown, Vergragt, Green, & Berchicci, 2003). While lower-order learning is adaptive and technical, identifying satisfactory solutions to known problems, higher-order learning, in contrast, "entails changes in the assumptions, norms and interpretive frames which govern the decision-making process and actions…or which underlie a policy discourse" (Brown & Vergragt, 2008, p. 110). It is not a search for satisfactory solutions to a given problem, but the reformulation of problem and process. Individuals who engage in higher- and lower-order learning do so through a process of collective discovery (Cunningham & Cunningham, 2008).

ULLs, in that respect, aim to enhance open innovation and learning—about what works—and in the process, develop innovation in interactive, participatory, or co-creation processes (Pallot, Trousse, Senach, & Scapin, 2010). With this knowledge, innovation can be improved and replicated in other places. ULLS aim to bring together multiple actors to be able to address contemporary urban challenges and foster learning through forms of open and engaged learning (Bulkeley et al., 2016). Those actors can contribute to the different phases of the innovation system that is being created by adding their own knowledge, employing a collective learning mechanism (Concilio & Molinari, 2014; Friedrich, Karlsson, & Federley, 2013). With the help of an experimental approach in a 'triple' or 'quadruple' helix mode, they bring science, policy, businesses, and civil society together (Lehmann, Frangioni, & Dubé, 2015; Matti, Edwards-Schachter, & Alcántara, 2012; Stahlbröst & Holst, 2013). Their structure can range from universities and science parks adopting user-driven approaches to regional clusters enabling a joint Quadruple Helix approach, as well as social actors and entrepreneurs aiming at excellence-driven innovations at local and international levels (Joint Research Centre, n.d.). The use of such models as the triple or quadruple helix recognises the value of partnerships and the different stakeholders and their roles in facilitating and supporting innovation (Mulvenna, Bergvall-Kåreborn, Wallace, Galbraith, & Martin, 2010). Although there have been different interpretations of ULLs, it is possible to identify some of the fundamental characteristics in the literature. For instance, Higgins and Klein (2011) refer to a real-world setting of these labs which brings in multiple stakeholders to interact. These ULLs respond to the increased complexity of urban climate challenges calling for local solutions that acknowledge the local conditions—political, technical, and social. In many ULLs, local innovations to climate problems are being developed, tried and tested, and improved, leading to urban innovations ready for repetition and upscaling. The involvement and participation of local stakeholders and citizens are generally considered as key to delivering solutions that are accepted. Nevertheless, it has been a challenging task to identify a direct link between the learning process and the innovation that take place in ULLs. Recently, Steen and van Bueren (2016) identified the characteristics of ULLs in an earlier study where they formulated the goals of ULLs such as developing new products to find new solutions to existing or new problems, producing and exchanging knowledge of the developed products and processes to achieve these products, and emphasizing the need for supported, local solutions.

Based on the ongoing debate, a conceptual framework has been developed to analyse our cases with a focus on understanding how learning and innovation have been implemented within ULLs (Figure 1). Our analytical framework is based on different loops of learning (Argyris & Schön, 1978; Brown & Vergragt, 2008; Brown et al., 2003) where the state-of-the-art of ULLs' innovation process and learning are examined by the operationalisation of the learning and innovation involved and how they are deployed. ULLs that engage in different loops of learning presume a process of collective discovery. One outcome of such a process can be the convergence of perspectives across stakeholders: Greater shared understanding can, in itself, be a successful learning outcome, forming the platform upon which to build future collaboration. Another outcome can be instrumental, i.e., when actors in ULLs learn on an instrumental level, they learn how to display the behavioural change as intended by the co-produced intervention and they can adapt their actions accordingly. This may even imply that they deviate from the intervention, for example, when a system is dynamic, a change of conditions and circumstances calls for modification of behaviour. Alternatively, learning can trigger actors within ULLs to develop a capacity to learn, allowing them to recognize and anticipate changes, and act upon them.

3. Methodology

To substantiate and develop our argument, we draw on our empirical material gathered from fieldwork in Buiksloterham, Amsterdam. Buiksloterham is widely perceived to be successful in the context of entrepreneurialism as it hosts diverse and extensive voluntary and community sectors that have developed a self-reliant and

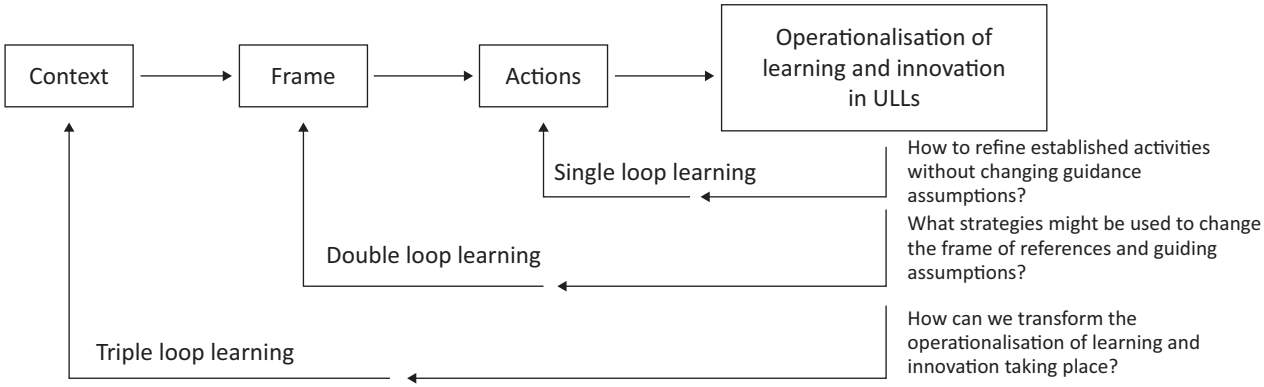

Figure 1. Theoretical framework. Source: Authors, based on Argyris and Schön (1978) and Hargrove (2002).

adversarial relationship with the city and have regularly come together for projects on sustainability and circular development. The article is informed by interviews carried out in 2017 as well as secondary data gathered through fieldwork conducted over 2018 and 2019. Data include newspaper articles, policy documents, academic reports, and official websites. In particular, we use three empirical case studies embedded in the Buiksloterham ULL in Amsterdam to understand the processes of learning in support of local innovation involving citizens. Conducting a case study of three embedded cases allows us to learn more about the rich and dynamic environment within which these developments took place. The selection of these embedded cases has a practical basis: By having the urban transformation of Buiksloterham as a case for education, we were able to actively follow developments in the cases studied over the years and to follow up on the initial analysis and interviews. A thick and context-rich understanding of cases helps to analyse and classify the learning in terms of the single, double, and triple loop-learning that took place, as well as by the different actors involved, and how the governance setting of the living lab contributed to the learning. Finally, we analyse the extent to which the cases have contributed to formalised or codified knowledge that can be shared in the form of replicable innovations. After all, that is what ULL's ultimately want: the city benefitting from knowledge that has been co-produced in an experimental setting.

The interviews that were held for each of the embedded cases, comprised interviews with key stakeholders involved (four for De Ceuvel, three for Schoonschip, four for the Manifesto; two of the interviewees were interviewed for both the case of the De Ceuvel and Schoonschip). Together with the interviewees, a reconstruction of the innovation process was made, supported with a physical timeline reflecting the key moments in the process that influenced its next phases (cf. Teisman, 2000). Interviewees were asked to identify the following in the process: events, decisions of influence (taken by themselves or others), actions, agreements reached, choices made (by themselves or others), as well as drivers or breakthroughs, and any setbacks or barriers in the process. They were also asked to think about influencing contextual factors—e.g., political, legal, economic, social, technological, and environmental factors.

At the beginning, a general timeline of a living lab was prepared with an aim to explore the different stages of an innovation process. With coloured sticky notes and a pen, stakeholders could add events and decisive moments to the process, as well as the contextual factors of influence on the process (see Figure 2 for an impression). The interviewer asked for more explanation while the interviewee was structuring the events. The interviewer was going to put the different timelines together afterwards but would ask during the interviewee for more explanation when recollections of the process and the product developed differed from the other interviewees' information or from the researchers' information from the document analysis carried out prior to the interviews. Consequently, interviewees were confronted with each other's perception of the process, while giving the interviewer, one of the researchers, a more comprehensive image of the process. This also gave the interviewer additional information on the dynamics of the case, e.g., regarding the motivations and interests of actors, the use of resources, the interactions between the actors involved, and the actions taken by different stakeholders. The final timeline and case description were sent to the interviewees for factual correction and feedback on the understanding of the case by the researchers. The interviews were held by the same interviewer, a junior researcher, who discussed the reconstruction and the analysis with the other, senior researcher. With the thorough knowledge of the cases based on the process reconstructions, the cases were also followed in 2018 and 2019 by continued document analysis and annual site visits with students, who analysed the case as part of an assignment in a course on sustainable urban development. The site visits included presentations by, or meet-ups with, stakeholders.

4. ULLs in Buiksloterham, Amsterdam

The three cases all took place within the context of the transformation of an industrial waterfront towards

Figure 2. Reconstruction of the timeline by one of the interviewees. Source: Courtesy of Kris Gyselle Steen.

a more mixed use of the area for residential, office, and industrial purposes. In 1999, the plan for the development of the transformation of the area was set in motion. In 2007, on the verge of plans starting to be realised, the financial crisis started: All plans were put on hold by the housing associations and private property developers who had purchased, or acquired development rights to, the land. In the following years, the municipality considered alternative ways to develop the area. It decided to start a process of incremental, or small-scale development of the area, which coincided with initiatives of local entrepreneurs who saw the crisis as an opportunity for replacing the more traditional plans, with a focus on profit and gentrification, with something more environmentally and socially concerned: focusing sustainability and a circular economy. This gave rise to a number of experimental approaches to urban development, with non-traditional stakeholders at the forefront, which as time went by, with the rise of the popularity of the concept amongst policymakers, be understood and generally referred to as ULLs.

In 2012, the municipality organised a contest for the temporary (10-year) use of a parcel of highly polluted land, the former shipyard De Ceuvel, in an attempt to stimulate placemaking activities that would promote the development of Buiksloterham. The plan for the development of an ecological, creative work community by local entrepreneurs, architects, and environmental consultants to put old boats onshore, connected by a boardwalk and with experimental bio-based soil remediation. In the course of time, increasing numbers of 'cleantech,' circular innovations would be tested at De Ceuvel. The community opened in 2014. For the various cleantech innovations, collaboration with specific knowledge institutes and local partners was sought in search of support and knowledge development and dissemination. In 2013, a subsidy of the Ministry of Economic Affairs supported the development of the project and the cleantech innovations in collaboration with another project in the same area, Schoonschip. Metabolic, the environmental consultant and key partner in the De Ceuvel, authored this report and also became involved in Schoonschip. By 2019, halfway into the 10-year period, De Ceuvel has become an example of best practice among ULLs, fulfilling the laboratory function, especially in the field of cleantech. In 2020, with the end of the 10-year lease period in sight, the temporary ambition, however, is being contested by the initiators, pointing at the fact that De Ceuvel continues to be a place for real-life innovation and experimentation while also having a communicative function as it hosts numerous visits and is a breeding ground for innovative small or starting enterprises.

Schoonschip is a sustainable floating residential community of 30 houses and about 48 households. Inspired by a pioneer living in a sustainable houseboat, two entrepreneurial individuals started the development of a plan for a sustainable floating community in 2008. Together with future residents, they sought a location. In 2010, they focused on a canal in Buiksloterham and they managed to get the municipality to tender the development of a plot there: Schoonschip, well-prepared and supported by future residents/community members, won the tender. In the further development of the technological innovations in the plan, mainly focusing on the reduction of waste and environmental impact of resource use, collaboration was sought with De Ceuvel, where partners were also looking for minimum impact technologies. They looked also for a project partner and knowledge institutes from The Netherlands and abroad who could support the development and implementa-

tion of sustainable technologies (e.g., sanitation, smart grid). In December 2018, the first seven floating houses arrived, the other 23 followed in 2019.

In 2007, at the start of the financial crisis, a local entrepreneur founded New Energy Docks, a temporary community of practice in Buiksloterham for companies aiming to bring sustainable solutions to the market. With plans for the area being put on hold due to the crisis, the temporary housing of the community became longer-term and the community started to play an active role in thinking of alternative, sustainable ambitions for the area. In 2010, the municipality handed out the first self-build plots to start small-scale development, to have some development while large players waited. The community of practice and the first self-builders started to collaborate on generating ideas for the sustainable and circular development of the area, along the way being inspired by the plans for De Ceuvel and Schoonschip. In 2011, this evolved into a local Buiksloterham community focusing on the sustainable and circular development of the area. To secure circular ambitions for the area in the future, they lobbied for a manifesto in which stakeholders committed themselves to the circular ambitions for the area as well as a formal status of the area as 'living lab' by the municipality. They were driven by the concern that developments would be resumed once the crisis passed, and stakeholders would fall back on traditional approaches to development and would forget the lessons in sustainable urban innovation that had been learned on in the meantime. Hence, they started to prepare a Manifesto for the circular development of the area, to be signed by all the area's stakeholders.

In April 2015, the Manifesto Circular Buiksloterham was signed by 20 professional private and public stakeholders. With their signatures, they supported the collaborative development of Buiksloterham as an innovative urban laboratory for small-scale innovative concepts. Stakeholders take joint responsibility for the whole area (Gladek, van Odijk, Theuws, & Herder, 2015). The Manifesto was accompanied by a report on the opportunities for circular development, co-authored by Metabolic, the local environmental consultancy firm that was rapidly growing after having co-initiated De Ceuvel and played a role in the development of the Clean Tech Playground in both De Ceuvel and Schoonschip. Later that year, the city council granted the area Buiksloterham a formal status as 'Living Lab,' with opportunities for a flexible rule regime. This also led to a formalisation of the Buiksloterham-community into a foundation 'City Lab Buiksloterham.' However, the precise meaning of the Living Lab-status was unspecified, as there were no precedents with such status. In the following years, up to 2019, the City Lab played a key role in facilitating the starting up, implementation, and dissemination of sustainable innovations by organizing events such as meet-ups and roundtables, while continuously brokering between the various stakeholders involved. The sustainability ambitions and targets formulated in the three living labs are presented in Table 1. Innovations are considered key to meet these targets.

5. Results

In this section, we analyse how the stakeholders in the three ULLs learnt, specified for the different orders of learning. In living labs, combining mechanisms of learning and embedding is key to promoting the development of particular local sustainable solutions. To recall (Section 2), single-loop learning concerns 'improving' without further reflection or adaptation; double-loop learning concerns the improvement and adaptation based on reflection; and triple-loop learning concerns a transformation, a systemic change. Table 2 shows an overview of a qualitative assessment of the learning resulting from the three living labs, based on the primary and secondary data collected, and the innovations being replicated. Since living labs explicitly focus on the production of formalized knowledge, to be of use to others, in other places, besides the usability for the partners within the living lab, we have focused on the employability of lessons in other projects (learning from the project), and less on the learning within the project.

The three living labs within the Buiksloterham area in Amsterdam all aimed to promote the sustainable development of the area or particular places within that area by developing innovations in both processes and technologies:

> The Living Lab status is necessary for establishing the overall character of the neighbourhood as a place where new technologies and management approaches can be applied and learned from. It is also instrumental in releasing developers and residents in the area from some legal restrictions that currently prevent the use of new materials and clean technologies in construction. (Gladek et al., 2015, p. 44)

Especially in the crisis years, from 2007 to roughly 2015/2016, many of the stakeholders were convinced that urban development would never be the same, and future projects would have to be of a small-scale nature, closely involving users and residents, and would be characterized by resource use in closed-loops, at the lowest scale possible to avoid transport losses and contribute to local value. The local experiments and implementation of the innovations developed would lead to lessons that could be applied, or further developed elsewhere.

The case analysis shows the importance of the participation of knowledge institutes and experts (consultants) for learning. They were key actors bringing in testable innovations and funds to do so, even though the ideas were often generated by the local communities involved, while they were also the ones bringing the innovations to other projects. Even though the living labs needed quite some learning on issues as governance, management, and organization, not just by the actors involved, but

Table 1. Sustainability ambitions and targets stated in three living labs in Amsterdam.

ULL	Ambitions	Targets
De Ceuvel: Temporary workplace for creative and social enterprises on polluted land	'Featherlight' footprint: minimized infrastructure on-site, with the possibility to leave the site without leaving much of a trace. Regenerative development: The phytoremediation plan and biodiversity measures will result in a cleaner and more biodiverse area than at the start of the project; Fast return on investment: Using a DIY approach and recycled materials, return on investment is possible in less than five years for all recommended interventions. Closed material cycles: reuse of nutrients and energy on-site. Evolving technology landscape: continuous improvement of system performance by adopting new technologies as they become available and affordable.	100% renewable heat and hot water supply 100% renewable electricity 100% wastewater and organic waste treatment 100% water self-sufficiency 60%–80% nutrient recovery 50%–70% reduction in electricity demand over conventional offices 10%–30% vegetable & fruit production using locally recovered nutrients sensor network and real-time system performance displays
Schoonschip: Sustainable floating residential community (30 houses, ≈ 48 households)	Shared use of communal facilities will increase community interaction and facilitate resource sharing. Demand-side management approaches which will limit overall resource demand. Reuse of nutrients and energy on-site, cascading of heat from waste sources for reuse in other functions (from greenhouses to the community pool). Evolving technology landscape: continuous improvement of system performance by adopting new technologies as they become available and affordable.	100% renewable heat and hot water supply 100% renewable electricity 100% wastewater and organic waste treatment 100% water self-sufficiency 60%–80% nutrient recovery 50%–70% reduction in electricity demand over conventional households 60%–80% vegetable & fruit production using locally recovered nutrients sensor network and real-time system performance displays
Manifesto/Living Lab Circular Buiksloterham to commit key stakeholders in Buiksloterham to sustainable, circular ambitions and goals	In April 2015, the Manifesto Circular Buiksloterham was signed by 20 professional private and public stakeholders in the area. The Manifesto was supported by a report specifying the circular ambitions for Buiksloterham. Later in that year, 2015, the municipality granted Buiksloterham a formal status as 'Living Lab,' with opportunities for a flexible rule regime. However, the meaning of this status was unspecified.	Technological goals: Developing BSH as an attractive area for innovations in water management. Developing and implementing a renewable energy vision. Developing a plan for sustainable mobility. Transforming polluted soil to fertile grounds for public value creation. Closing material flows with keeping value as high as possible and at the appropriate scale. Systemic goals: Recognizing BSH as a living lab. Developing a governance approach supported by all stakeholders. Developing new financing instruments/structures. Developing open data monitoring systems.

also by the environment in which they operated, these lessons do not seem to have been picked up by actors in the wider environment.

With the property market picking up in 2016 and getting rapidly overheated again, many actors regret that the present conditions give no room for adopting the lessons learned during the crisis. With regards to the importance of the involvement of citizens and end-users in the development of innovation, the three living labs show a rather weak engagement of these groups. This may be explained by the technical focus of the labs, and the absence (back then) of many residents in the industrial area when the labs started. This would be a factor to take into account when applying the innovations in other places.

6. Towards Innovation To Be Replicated

In a Living Lab, it is essential to harmonise the innovation process amongst stakeholders so that they can benefit from the process in different ways. This can be seen, for example, in how companies can get new and inno-

Table 2. Learning and innovation resulting from three living labs in Amsterdam.

ULL	Single-loop learning	Double-loop learning	Triple loop learning
De Ceuvel: Workplace for creative and social enterprises	On particular innovations (cleantech) by directly involved actors. The involvement of a starting environmental consultant and landscape architect as initiators willing to invest a lot of time to develop the concept while developing a breeding location where they could reside and prove and showcase their concepts was key. The land made available by the municipality for a 10-year period was essential for the financial viability of the plans. The technical innovations in the plan were developed with the support of established knowledge institutes who knew how to apply for a subsidy to develop the innovations.	On the initiation and development of innovations, on issues as fundraising, collaboration, testing, etc. (e.g., the project CleanTechPlayground included learning on cleantech in both De Ceuvel and Schoonschip). The initiators involved learned how to create the conditions for single-loop learning by collaborating with established stakeholders, well-experienced with raising (political) support and funding. In 2020, de Ceuvel was still a place for single-loop and double-loop learning on innovations and the conditions for implementation.	De Ceuvel demonstrates that it is possible to use polluted land temporarily for creative industry breeding places, thus contributing to 'place-making' and innovation. By showcasing the success of the project by the initiators, promoting the replicability of the innovations and the innovation ecosystem created at De Ceuvel, the unique project conditions should be emphasized as well: free land for a 10-year period. Over the years, De Ceuvel has become a permanent testing ground for these initiators, which they would like to keep. This is at odds with the temporary concept of the plan and could potentially reduce De Ceuvel's innovative character, urging it to operate under more normal market conditions.
Schoonschip: Sustainable floating residential community (30 houses, ≈ 48 households)	On particular innovations (cleantech and smart grids) by directly involved actors, such as the municipality and the local water company, and the future residents. Since the realisation of Schoonschip, the systems can be improved based on the feedback of real-life users.	The initiating (community of) residents learned on how to collaborate with knowledge institutes and local partners as key enablers to provide support in terms of knowledge, subsidies and municipal support for innovation. They also learned how to organise the community, to keep everyone 'on board.' The affordability of the housing at this location became a supportive driver for this when the economy started to grow again.	The municipality has learned on the opportunity of floating urban development, and on how to collaborate with citizens' initiatives. The leading role of the community of future residents in the development of the concept will reduce the direct replicability of the concept by other communities, the municipality or developers, since this may lead to other demands and concepts.

Table 2. (Cont.) Learning and innovation resulting from three living labs in Amsterdam.

ULL	Single-loop learning	Double-loop learning	Triple loop learning
Manifesto/Living Lab Circular Buiksloterham	By the Buiksloterham community and later the City Lab, and the Manifesto partners on opportunities for sustainable and circular urban development.	By the initiators of the City Lab with regards to the formulation of ambitions and laying it down in formal statements, policy documents and policy instruments, and in building coalitions for support; how a joint declaration can be used to build momentum.	The community and later City Lab learned that having a formal declaration and status did not automatically lead to the implementation of ambitions; on the contrary, with the In the midst of the many sustainable innovations taking place, and new companies and residents moving into the newly developed plots in the area, the foundation City Lab had to reposition itself to keep its role and legitimacy as a knowledge broker and central contact for the municipality and stakeholders in the area. Without formal stakes in the area, in terms of land, buildings, or projects, it is difficult to claim such a position, both towards landowners/users/residents and the municipality and developers. To the central government, the City Lab does play a role in showcasing the benefits of a Manifesto and especially asking attention for removing regulatory barriers for implementation of innovations.

vative ideas, users can get the innovation they want, researchers can acquire case studies, and public organisations can get increased return on their innovation research investments (Stahlbröst & Holst, 2013). Therefore, as a co-creative environment, ULLs can provide an essential platform to connect various impacts. This is also essential as the increasing number of social and environmental challenges we face involve actors from different organisations with different needs. The application of various learning loops, as has been demonstrated earlier, can demonstrate how people, organisations, and groups can modify their actions. In fact, these learning loops, theoretically speaking, are designed so that through open and engaged learning, the variety of actors involved during the process can contribute to the different phases of the innovation system via a collective learning mechanism (Concilio & Molinari, 2014; Friedrich et al., 2013).

This kind of experimental approach not only brings a variety of different actors together but also recognises the value of partnerships and the different stakeholders and their roles in facilitating and supporting innovation (Mulvenna et al., 2010). However, when the learning theories are applied in real settings, the replication of innovation can be problematic because learning theories are especially concerned within a particular learning setting. In ULLs, on the other hand, actors learn within a particular context, while the expectations of policymakers, industry, citizens, and knowledge institutes is that the lessons learned will be useful for other contexts, i.e., the innovations need to be of use in other contexts as well. In our cases, what we have seen is that there is a wide range of actors involved in disseminating the learning and information.

In the case of De Ceuval and Schoonschip, various knowledge institutes, consultants and the local water company help to disseminate lessons to other locations within Amsterdam and beyond. On the other hand, for Manifesto/Living Lab Circular Buiksloterham, the City Lab exchanges experiences with similar 'bottom-up' ini-

tiatives in other cities and promotes the relevance of the development of, and signed commitment to, shared ambitions amongst innovative stakeholders, local enterprises, (future) residents/users, and professional actors with a short- or long-term stake in the area. The innovations have been directed at small-scale developments, set in the midst of the financial crisis when large-scale development was something of the past. However, once the projects are set up and stakeholders identified, the learning processes and governance leading to co-production of knowledge remains ambiguous mainly due to the more informal relationship between private and public stakeholders. The same thing also applies in relation to citizen involvement. Nevertheless, to be able to develop a learning ecosystem where reciprocal experiences remain essential for replicating innovation and embedding the learning, it is essential to develop the 'community' relations between various stakeholders.

7. Conclusion

This article draws on qualitative evidence collected from three ULLs in Amsterdam to convey some of the diversity in local practice and experiences. While some conceptualised their ULL activities explicitly in terms of structured learning through experimentation, e.g., driven by requirements of granted subsidies, other learning processes were more informal. There can be an element of learning-by-doing, where local actors are discovering for themselves, for example, the possibilities for seeking innovative solutions. The case studies provide examples of actors bringing stakeholders together to sensitise them to the possibilities of local innovations. We have also shown that ULLs display a large emphasis on learning. These learning processes have been further specified with the help of an analysis of the most important learning models from learning literature. Through interviews with participants in the ULLs, the learning processes in ULLs in Amsterdam have been investigated and compared to the theoretical hypotheses. This has led to insight on where and why practice deviates from theory regarding the learning processes in ULLs, appointing areas of attention for the successful implementation of learning processes in ULLs in practice and already allowing us to draw some lessons in this field.

When comparing the real enrolment of learning processes in ULLs in practice to theory, we see one large difference between the theoretical representation of learning and the situation in practice. The established learning models rely on or simplify the real situation according to the hypothesis that all learning activities are performed by one actor and take place in the same system. Practice shows us that in ULLs however, it is not the learning ULL that must apply the lessons, it is another project that must do so (Mulvenna et al., 2010). This creates what can be considered a learning ecosystem in which the overall learning process goes across actors and projects, not applying to living labs on an individual level, but to sustainable urban development projects as a system (Friedrich et al., 2013). This requires some sort of 'interactive collective social learning model,' in which learning is not acquired from personal experiences, but from reciprocal experiences, very much emphasizing the importance of transfer and distribution of lessons/knowledge.

Today, the embrace of experimental urbanism results in diverse innovative activities interacting with existing infrastructures, governance structures, and sociopolitical legacies (Hodson, Geels, & McMeekin, 2017, p. 8). While the institutional matrix through which experimentation occurs diverges markedly between urban areas (Raven, Kern, Verhees, & Smith, 2016), multiple experiments can be conducted simultaneously within the same urban space and to think in terms of transitions. Cities facing declining public resources are driven to seek cost savings, alternative income sources, and new activities to sustain local economies; ULLs offer an alternative bottom-up approach. As technology advances, new social actors join collaborations, necessitating further rounds of learning. Nevertheless, the transition through which ULLs move from small-scale pilots to broader social embedding is a precarious process without a solid institutional framework. As the cases have shown in this exploration, this may lead to a mismatch between the scale and context of experiments, e.g., innovations that can only be applied on a small scale, innovations that require an existing community of (future) residents, or a formal status existing but without any institutional embedding in terms of political support, position, resources, or influence.

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Conflict of Interests

The authors declare no conflict of interests.

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