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Urban Planning and the Smart City: Projects, Practices and Politics

Editors

Andrew Karvonen, Matthew Cook and Håvard Haarstad

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Editorial

Urban Planning and the Smart City: Projects, Practices and Politics

Andrew Karvonen [1,*], Matthew Cook [2] and Håvard Haarstad [3,4]

[1] Department of Urban Planning and Environment, KTH Royal Institute of Technology, 100 44 Stockholm, Sweden; E-Mail: apkar@kth.se
[2] School of Engineering and Innovation, Open University, Milton Keynes, MK7 6AA, UK; E-Mail: matthew.cook@open.ac.uk
[3] Centre for Climate and Energy Transformation, Faculty of Social Sciences, University of Bergen, 5020 Bergen, Norway; E-Mail: havard.haarstad@uib.no
[4] Department of Geography, Faculty of Social Sciences, University of Bergen, 5020 Bergen, Norway

* Corresponding author

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Abstract
Today's smart city agendas are the latest iteration of urban sociotechnical innovation. Their aim is to use information and communication technologies (ICT) to improve the economic and environmental performance of cities while hopefully providing a better quality of life for residents. Urban planners have a long-standing tradition of aligning technological innovation with the built environment and residents but have been only peripherally engaged in smart cities debates to date. However, this situation is beginning to change as iconic, one-of-a-kind smart projects are giving way to the 'actually existing' smart city and ICT interventions are emerging as ubiquitous features of twenty-first century cities. The aim of this thematic issue is to explore the various ways that smart cities are influencing and being influenced by urban planning. The articles provide empirical evidence of how urban planners are engaging with processes of smart urbanisation through projects, practices, and politics. They reveal the profound and lasting influence of digitalisation on urban planning and the multiple opportunities for urban planners to serve as champions and drivers of the smart city.

Keywords
digitalisation; innovation; planners; smart cities; urban planning

Issue
This editorial is part of the issue "Urban Planning and the Smart City: Projects, Practices and Politics" edited by Andrew Karvonen (KTH Royal Institute of Technology, Sweden), Matthew Cook (Open University, UK) and Håvard Haarstad (University of Bergen, Norway).

Urban planning practices have always been closely intertwined with technological development. From the rise of nineteenth century infrastructure networks to the introduction of automobiles, streetlights, spatial analysis tools, personal computers, and the World Wide Web, planners have been tasked with mediating and aligning society and technology to produce contemporary cities (Coutard & Rutherford, 2015; Graham, 2001; Graham & Marvin, 1999; Kurath, Marskamp, Paulos, & Ruegg, 2018; Rutherford, 2020). Today's smart city agendas embody the latest iteration of sociotechnical innovation with the promise of using information and communication technologies (ICT) to improve the economic and environmental performance of cities while hopefully providing a better quality of life for residents.

The rise of smart cities has catalysed numerous debates around the heightened role of technology firms in the management of collective urban services (Coletta, Evans, Heaphy, & Kitchin, 2019; Karvonen, Cugurullo, & Caprotti, 2019), the importance of global competition in attracting businesses and residents (Hollands, 2015; Söderström, Paasche, & Klauser, 2014), and the dangers of privatising infrastructure networks (Marvin, Luque-Ayala, & McFarlane, 2015; Viitanen & Kingston, 2014). At the same time, the influence of urban planners has been surprisingly muted, despite the fact that smart city agen-

das are "challenging longstanding principles and practices of planning" (Späth & Knieling, 2020, p. 3). Indeed, the smart city competes with (and sometimes overshadows) sustainable urban development agendas (Evans et al., 2019; Haarstad, 2017; Parks & Rohracher, 2019; Yigitcanlar et al., 2019) and tends to promote universal standards that reinforce a "reductionist mode of urban planning and development" (Joss, Cook, & Dayot, 2017, p. 31). Cowley and Caprotti (2019) go so far as to characterise the smart city as a form of 'anti-planning' that is rapidly replacing the normative foundations of the profession with notions of efficiency, standardisation, and corporate control. These critiques raise significant questions about how planners and incumbent planning practices are currently contributing to smart cities and more importantly, how they should contribute in the coming years. In short, what is the role of urban planning in the twenty-first century smart city?

The aim of this thematic issue is to explore the various ways that smart cities are influencing and being influenced by urban planning agendas and actions. The contributors draw on theories and perspectives from urban planning, human geography, science and technology studies, political science, public policy, and sustainability science to interrogate the social and material aspects of contemporary smart city activities. The emphasis on urban planning situates smart urbanisation and the enthusiasm for digitalisation in the longer, multi-faceted trajectory of urban change. Specifically, the authors explore how smart urbanisation is simultaneously ignoring, superseding, and reshaping urban planning practices while also highlighting the ways that urban planners are intervening in these activities.

The first two articles in the collection emphasise the political aspects of smart cities and urban planning through case studies of the globally renowned and highly controversial Quayside development in Toronto. Constance Carr and Markus Hesse (2020) adopt a post-political perspective to interpret the actions by Sidewalk Labs (a subsidiary of Alphabet and sister company to Google) in subverting and dominating land use development practices to prioritise private interests over the public good. They emphasise the potential negative impacts of the project on public services of transportation and housing as well as the labour market and illustrate the multiple ways that public authorities are increasingly vulnerable to corporate influence. Kevin Morgan and Brian Webb (2020) compare and contrast the technocentric and citizen-centric narratives that have emerged around the Quayside development and note a distinct lack of engagement by urban planners in mediating these frequently opposing agendas. However, recent citizen-led protests have forced the public authority to rethink its role and this has the potential to steer the development in new directions. Both articles highlight the intense conflicts that arise when sociotechnical innovation is fused with future urban land use planning.

A common characteristic of many smart cities programmes and projects is the reliance on experimentation to test new technologies in situ (Cook, Horne, Potter, & Valdez, 2018; Evans, Karvonen, & Raven, 2016; Karvonen, 2018). Lina Berglund-Snodgrass and Dalia Mukhtar-Landgren (2020) draw on neo-institutional theory to compare and contrast how the traditional 'public sector' logic of urban planning is influenced by an emerging 'experimental logic' that they characterise as 'testbed planning.' They argue that there is a clear disconnect between experimental activities and long-term planning practices and raise questions about how the knowledge generated in experiments can inform the long-term planning and development trajectories of cities. Katharina Lange and Jörg Knieling (2020) also examine the role of experiments as they relate to urban planning with a specific focus on how externally funded experiments are integrated into local development agendas. The authors use a multi-level governance framework to examine how Horizon 2020 grant funding from the European Commission was used to create an experimental low-carbon smart district in Hamburg. Their research shows how urban planners translate and rework international smart aspirations to align with long-term, context-specific development dynamics.

The final two articles of the thematic issue focus on the influence of digitalisation on urban planning. Ashlin Lee, Adrian Mackenzie, Gavin Smith, and Paul Box (2020) summarise the rise of platform urbanism to illustrate how the digitalisation of collective urban services creates new modes of governance. Their survey of urban data projects around the world reveals the dominance of corporate actors and the promotion of standardised digital practices that lock customers into specific modes of service provision while locking out competitors and alternative approaches. At the same time, they identify multiple examples of how public authorities can design and manage platform services to support community and social groups rather than corporate shareholders. Zipan Cai, Vladimir Cvetkovic, and Jessica Page (2020) examine digitalisation from a different perspective by focusing on land use development dynamics in the contemporary city. The authors use a 'fuzzy' statistical approach to develop quantitative indicators that reveal the influence of digitalisation on the broader industrial, economic, and social sectors. Their findings suggest the need to focus not only on discrete smart districts and programmes, but also on the more pervasive influence of digitalisation on all facets of urban life.

As a whole, the articles illustrate how the projects, practices, and politics of smart urbanisation are influencing and being influenced by urban planning activities and actions. Planning smart cities involves the development and application of digital tools and systems that can celebrate the diverse, distinctive, and inherently messy character of specific locales rather than support the drive towards more sanitised, generic, and one-dimensional global cities (Aurigi & Odendaal, 2020; Kaika,

2017). Moreover, smart cities are deeply influenced by 'glocal' practices of knowledge politics and urban planners need to engage with and influence those global knowledge networks that are shaping local urban development (Davidson, Coenen, Acuto, & Gleeson, 2019; Wathne & Haarstad, 2020). Finally, there is a need to recognise smart cities not as a technological agenda but rather as a sociotechnical agenda that involves fundamental social, political, and cultural changes (Evans et al., 2019; Glasmeier & Christopherson, 2015; Karvonen et al., 2019). Planners are ideally positioned to identify and shape the relations between technological innovation and society in smart cities by forwarding collective interests and serving as guardians of the public good.

Today's smart technologies provide urban actors with the ability to generate and share data to inform existing decision-making processes and to hopefully make cities more sustainable, resilient, and liveable. In the not-so-distant future, more sophisticated applications of machine learning and artificial intelligence will have profound and far-reaching influence on urban metabolisms and human life. It is tempting for one to be pessimistic about the rise of the smart city and the increasing influence of big technology corporations on the intimate lives of urban residents. However, the evidence presented in this thematic issue suggests that who and what controls the smart city is still up for debate. Ultimately, this serves as a clarion call for urban planners to fully engage the smart city, serving not only as partners and collaborators in public-private, triple and quadruple helix partnerships, but also as champions for directing technological innovation towards the improvement of urban governance and collective services while always serving the public at large. Planners and planning practices have been bypassed by the smart city agenda for too long; it is time for this to change.

Conflict of Interests

The authors declare no conflict of interests.

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About the Authors

Andrew Karvonen is Associate Professor and Director of Doctoral Studies in the Department of Urban Planning and Environment at the KTH Royal Institute of Technology in Stockholm. He conducts research on the politics and practice of sustainable urban development with a particular focus on infrastructure networks and how they integrate nature, technology, and society. His most recent book, edited with Federico Cugurullo and Federico Caprotti, is *Inside Smart Cities: Place, Politics and Urban Innovation* (2019, Routledge).

Matthew Cook is Professor of Innovation and leader of the Future Urban Environments research team in the School of Engineering and Innovation at the Open University, UK. Matt's research interests are in innovation and the development of more sustainable urban environments. Working at the intersection of innovation studies and urban studies his work recognises the situatedness of innovation and the inherent spatiality of this complex socio-technical process. Much of Matt's current work is concerned with critical perspectives on the governance of smart city innovations, such as urban energy and transport systems, and the policy mobilities that play a profound role in their (re)construction.

Håvard Haarstad is Professor at the Department of Geography, and Director for the Centre for Climate and Energy Transformation, at the University of Bergen, Norway. In his research, he is broadly interested in sustainability, climate change and energy, particularly in relation to cities. Among other projects, he currently leads the project 'European Cities as Actors in Climate and Energy Transformations', funded by the Trond Mohn Foundation.

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Article

When Alphabet Inc. Plans Toronto's Waterfront: New Post-Political Modes of Urban Governance

Constance Carr [1,2,*] and Markus Hesse [1]

[1] Department of Geography and Spatial Planning, University of Luxembourg, 4365 Esch-sur-Alzette, Luxembourg; E-Mails: constance.carr@uni.lu (C.C.), markus.hesse@uni.lu (M.H.)
[2] CITY Institute, York University, Toronto, M3J 1P3, Canada

* Corresponding author

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Abstract
'Smart cities' has become a hegemonic concept in urban discourses, despite substantial criticism presented by scholarly research and activism. The aim of this research was to understand what happens when one of the big digital corporations enters the field of real estate and land use development and urban planning, how existing institutions respond to this, and how modes of urban governance are affected. Alphabet Inc.'s plans for Toronto's waterfront provided insights into these questions. Our investigations traced a complex web of place-making practices that involved all levels of government, the general public, and networks of actors throughout the private sector. Methodologically, the discourse was reconstructed with local fieldwork, interviews with key actors, participating in tours and public meetings, and secondary sources. It was found that Alphabet Inc.'s plan to build a world-class digital city contained some lessons for urban studies and urban planning practice. First, Alphabet Inc.'s plans, which unfolded amidst initiatives to expand the knowledge economy, confirmed concerns that the trajectory of neoliberal, market-driven land use and speculation along the waterfront remains unchanged. Second, digital infrastructures are potentially a Trojan Horse. Third, it was seen that municipalities and their modes of urban planning are vulnerable to the political economic manoeuvrings of large corporate power. Fourth, Alphabet Inc. operates as a post-political package driven by a new coalition of politics, where the smart city is sold as a neutral technology. The controversies surrounding the project, however, stirred a civic discourse that might signal a return of the political.

Keywords
digital cities; governance; post-politics; smart cities; Toronto; urban planning

Issue
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1. Introduction

The aim of this article is to demonstrate what happens when one of the big digital corporations enters the field of land use development and urban planning. We are particularly interested in how public institutions respond to such developments and how the usual modes of urban governance and planning are impacted. The case of Alphabet Inc.'s plans for developing the Port Lands district of the City of Toronto (the City), Canada, provided excellent insight into these questions. In 2017, Sidewalk Labs (SL)—a daughter company and urban development arm of Alphabet Inc. and sister to Google LLC—won the competition to develop 4.9 hectares along Toronto's shores of Lake Ontario. The project, known as Quayside, grabbed substantial media

attention; however, observers also wondered about the implications for urban planning practices and modes of urban governance both there and everywhere, because never before had a world leader in technological innovation of such scale ever attempted to make in-roads into the field of urban planning, as urban developers.

Our background research began in 2017 and coincided—as did the announcement about Quayside—with the hype around urban digitalization that had rendered the smart city into a powerful and hegemonic concept, or imaginary, in urban planning (Sadowski & Bendor, 2019). Such hype was propagated, for example, by the Royal Town Planning Institute (2017) in the UK, which wrote about the future smart city as the answer to far-reaching challenges facing city managers, planners, and residents. Similarly, Bitkom e.V. and Fraunhofer IESE (2019) released an overview of over 50 German cities showcasing smart city agendas. Just about any city that had implemented any kind of digital device or system (such as traffic lights or driverless cars) was now classified as smart. And, there are meanwhile entire cities being built across Asia based on smart city principles (Hollands, 2015).

Along with scholars such as Ash, Kitchin, and Leszczynski (2016), Kitchin (2015), or Wiig (2018), we contend that there are unexpected consequences and externalities associated with the rise of smart cities and urban digitalization. These are not critical assessments of technology itself, as technological determinism and the complex relationship between urban development, urban planning, politics, and innovation are well understood. Rather, contemporary urban studies literature addresses broader debates about the modes, discourses, contradictions, and socio-political and economic processes that constitute geography's 'digital turn' (Ash et al., 2016; Graham, Kitchin, Mattern, & Shaw, 2019; Hajer, 2015; Karvonen, Cugurullo, & Caprotti, 2019; Kitchin, 2015).

Several unsolved problems with the smart city model have been documented (Cardullo, di Feliciantonio, & Kitchin, 2019; Glasmeier & Christopherson, 2015; Hollands, 2008, 2015; Kitchin, 2015; Shelton, Zook, & Wiig, 2015). These include questions about: (1) the epistemologies that inform data production; (2) ownership and regulation of data processed in remote geographic locations; (3) the problem of smart city agendas driven by companies who see cities as burgeoning markets for their digital products; and (4) the commodification of public services, lock-in effects, and consequences of standardization. With respect to Alphabet Inc., specifically, Tomlinson et al. (2010, p. 188) concluded that Google's search engines produced a hegemony of urban planning concepts that excluded "alternative perspectives and policy options." Observing Google Fiber's provision of infrastructure in Kansas City, Alizadeh, Grubesic, and Helderop (2017, p. 984) concluded that "urban governments need to develop a suite of operational checks and balances to assure the equity of access to service in their dealings with big corporations." These findings deliver important insights into questions about how intermingled governments and large digital corporations should be, and where the lines between them ought to be drawn (Alizadeh et al., 2017, p. 974), given the costs and opportunities of enlisting the services of large digital corporations and the need for cities to keep pace with technological change despite limited resources (Alizadeh et al., 2017; Caprotti, 2018; Haarstad, 2017; Rossi, 2016; Wiig & Wyly, 2016).

Toronto's waterfront development exhibits a new incarnation of digital cities: an urban development model that is driven by a single large digital corporation, while local public policy is situated in a vacuum. Our research shows that the Quayside project was put onto Toronto's urban planning agenda by means that were neither transparent, nor driven by urban policy and planning. The mode of urban governance was thus post-political, as defined by Wilson and Swyngedouw (2014) and reflected in the works of Davidson and Iveson (2015), Deas (2014), Legacy (2018), MacLeod (2011), Mouffe (2005), and others. In our research, the post-political reading of Toronto's urban governance is exemplified by a cleft between politics and the political, and is evidenced by the strategic behaviour and the lack of communication on the part of governing authorities in charge of land use and urban planning. This article, on one hand, thus explains the case of Quayside as a cautionary tale to urban planners and development practitioners concerned with the limits of smart city models. On the other hand, this article also explains Quayside as yet another form of post-political urban development, and thus contributes to urban studies scholarship that conceptualises contemporary urbanity.

The argument is organized as follows. First, we introduce the conceptual lens of post-political governance, which magnifies the changes in urban policy-making and politics, when big corporations like Alphabet Inc. enter the field of urban planning and development. Second, we explain the methodology, comprising of mainly of non-standardized methods of inquiry such as document analyses, in-depth expert interviews and participant observation at community meetings. Third, the case of Quayside is presented, situated in the context of a new phase in Toronto's waterfront development. Here, SL's alignment with Canadian politics is seen, as are the possibilities and limitations of a political civic response. Fourth, conclusions are made concerning the key lessons for urban planning and urban studies scholarship.

2. Urban Governance and Post-Political Developments

One of the big debates in urban studies scholarship concerns the changes in governance configurations and related practices that have taken shape in urban regions across Europe and North America in recent decades (Brenner & Theodore, 2002). Throughout the years, cities—or better, city-regions—have become more and more integrated into global production networks as

hot spots in the emerging services industries, and reconfigured as strategic, competitive locales for cognitive-cultural capitalism (Krueger, Gibbs, & Carr, 2018; Scott, 2001). In terms of urban governance, most notable changes include the rise of corporate power within a neoliberal framework, a related shift from managerial to entrepreneurial urbanism, and an increasingly competitive positioning of urban politics (McCann, 2017, pp. 313–314). Broadly speaking, these changes triggered the current configuration of many cities as "crucial sites in the circulation of capital, culture and mobile policy" (MacLeod, 2011, p. 2632). MacLeod claims that cities have become:

> Glittering commercial citadels…of iconic development…[with] globally mediated bidding process[es] to host prestige exhibitions and magnetic arts, cultural and sporting venues and events…[often transforming] former industrial inner-city zones into mixed-use creative cultural quarters, buzzing economic districts, heritage and tourism villages and gentrified apartments…orchestrated by state-led coalitions and special-purpose agencies whose aim is to boost urban economies amid a quicksilver globalising capitalism. (MacLeod, 2011, p. 2630)

Indeed, previous studies of Toronto's urban development informed MacLeod's (2011) observations above. And, as confirmed elsewhere, Toronto's condominium boom (Rosen & Walks, 2014), transit developments (Keil & Addie, 2016), and mega event plans (Bellas & Oliver, 2016) have all been described as post-political processes. Certainly, this article adds to this area-based inventory of post-political processes in Toronto, and furthers other debates that examine the (im)possibility of the political in cities (Beveridge & Koch, 2017; Davidson & Iveson, 2015; Deas, 2014; Gray, 2018; Kenis & Lievens, 2017; Legacy, 2018; Mössner, 2016; Paddison, 2009; Richter & Fitzpatrick, 2018; Swyngedouw, 2011).

Informed by critical analyses of cities and urban spaces from around the globe, scholarly debates shed light on post-political developments, as a means of understanding the fuzzy practices situated between the power of big politics and the characteristically messy political processes. Wilson and Swyngedouw (2014) provide a useful starting point for understanding both the origins of the concept as well as one pole of the heated scholarly discussion. They conceived the post-political in terms of a Lacanian Borromean Knot, i.e., intertwined registers of the Real, Symbolic, and Imaginary, whereby one cannot be separated out without unravelling the others, and together the registers constitute dimensions of the post-political. In short, the Imaginary can be understood as the production of overarching narratives that function to supplant all dissent with a higher priority (Wilson & Swyngedouw, 2014). Wilson and Swyngedouw (2014, p. 7) used the example of the "end of history" narrative as one that sanctified the new global capitalist order. The Symbolic is when politics is reduced to consensual management, and the idea, memory, or notion of deliberation is merely invoked but not practiced. The Real refers to the ontological elimination of difference across political spheres (Wilson & Swyngedouw, 2014).

There are careful, if not contested, definitions to recall here (Wilson & Swyngedouw, 2014): The political is "the space of contestation and agonistic engagement" while politics refers to the "technocratic mechanisms and consensual procedures that operate within an unquestioned framework of representative democracy, free market economics, and cosmopolitan liberalism" (Wilson & Swyngedouw, 2014, p. 6). In post-politics:

> Political contradictions are reduced to policy problems to be managed by experts and legitimated through participatory processes in which the scope of possible outcomes is narrowly defined in advance. 'The people'—as a potentially disruptive political collective—is replaced by the population—the aggregated object of opinion polls, surveillance, and biopolitical optimisation. Citizens become consumers, and elections are framed as just another 'choice.' (Wilson & Swyngedouw, 2014, p. 6)

For Wilson and Swyngedouw (2014), Chantal Mouffe is one of the key thinkers of post-politics. According to Mouffe (2005), political adversity—antagonism—is a necessary component of functioning democracies; however, this is repressed in post-democratic regimes as politics strives for hegemony, while the political strives to subvert it. Some have observed this, for example, in urban regeneration initiatives that claim to be progressive, calling for local participation and collaboration, but are void of debate and contestation (see Gray, 2018). We argue that Quayside represents a classic case of Mouffe's (2005) condition of the post-political where deliberation is void of oppositional debate (Wilson & Swyngedouw, 2014), and politics is severed from the political (Mouffe, 2005). This split between politics and the political was a key feature of Toronto's and Canada's dealings with Alphabet Inc. This invokes the first lesson for urban planning practice—that processes are opaque—and a second lesson about the character of (post-)politics when powerful corporations want to do urban development.

There is a second current in the post-political literature that is also instructive. Authors, here, are concerned with "the post-political trap" (Beveridge & Koch, 2017). These authors argue that the prevailing binary of politics and political potentially occludes both the plurality of "actually existing multiplicity of voices and forms of contestation" (Kenis, 2019, p. 833), and by extension, the urban as a setting for resistance (Kenis, 2019). Richter and Fitzpatrick (2018) challenge the concept that post-politics is a condition that merely unfolds unimpeded: If politics has merely sanitized the political, then it is difficult to account for actual movements of resistance, community actions, or positions.

In this article, we contend that big tech corporations in general and smart city discourses in particular are prone to pushing a neutral, expertise-led, technological agenda that is post-political. However, we also see the possible emergence of a *realpolitik*. When SL entered the field of urban planning, it also sparked a resistance that cannot be "written off as post-political" (Kern & McLean, 2017, p. 410). Legacy, Cook, Rogers, and Ruming (2018, p. 2) are helpful here: "Post-political theorists claim that formal, state-created processes and spaces for participation increasingly offer no grounds for actual public debate, nor legitimate spaces for contestation." While SL became a central actor in Toronto urban planning alongside Canadian politics, urban residents established new spaces to engage in the political (see Legacy, 2018, p. 77).

3. The Research Approach

The research began in 2017 (Carr & Hesse, 2019), when Waterfront Toronto (WT)—the agency in charge of property development along the lakeside and in the Port Lands—announced that SL won its competition to develop Quayside (Figure 1). At this point in time, big tech corporations had already gained some attention concerning their possible stakes in urban development, particularly after Amazon.com instigated a competition for the location of its second headquarters (HQ2; Nager, Lowe Reed, & Langford, 2019). The announcement that Alphabet Inc. was interested in developing Toronto's waterfront signalled another opportunity to examine what happens to urban governance processes when large corporations from the digital economy get involved.

To comprehend the complexities of urban politics in Toronto—Canada's most populous city—and around a project such as Quayside, the research focused on both the contextuality of SL's arrival on Toronto's urban planning and development scene, and the processuality of Toronto's urbanization. The latter has roots in urban political ecology as developed by scholars such as Keil (2003), Bunce and Desfor (2007), and Angelo and Wachsmuth (2014), who draw on Lefebvre (2003) and focus on the processes of production as constitutive of urban change, because, as Keil (2003, p. 725) articulates it, "'the urban' is a complex, multiscale and multidimensional process where the general and specific aspects of the human condition meet." We thus applied a qualitative research approach common in both human geography and urban studies as a means of understanding and analyzing urban politics and political processes (see Kenis, 2019; Mössner, 2016). The research design "aimed to arrive at a thick and rich description of the discourses developed by…participants" active in the field (Kenis, 2019, p. 836). While Kenis (2019) sought to tease out the various discourses of two different activist movements, our work aimed at identifying and reconstructing the different discourses produced by both politics and the political.

Secondary sources were central in understanding the situation in broad strokes and for identifying key actors and institutions. A wide variety of media outlets and documents were available for assessment. There was also a wealth of videos available on the internet, such as recordings of public events organized by SL or WT, interviews with politicians, or public announcements. SL also has a significant number of relevant videos on its dedicated website, Sidewalktoronto.ca.

The next step entailed exploring the site, meeting key actors in the field, and triangulating their narratives against the written discourse. Working in collaboration with local institutions, Carr spent a total of three months in downtown Toronto: four weeks in the spring of 2019, and eight weeks in early autumn, 2019. During this time, Carr, who had also lived in the waterfront district (the St. Lawrence Neighbourhood) for 20 years, was able to update prior knowledge of socio-political and institutional structures in the area, and build that into the study.

On-site research included meetings with scholarly experts knowledgeable of Torontonian social movements, urban planning and development practices, legalities of land use, local political processes and institutions of politics, and urban transformation along the waterfront and in the Port Lands. A total of ten voluntary, circa hour-long conversations were held. While it was always clear that this was a research trip, Carr was on friendly terms with most of the participants and the conversations were informal in character (recall Mössner, 2016). The goal of these conversations was to not only learn about the contemporary Toronto context and receive direction or hints towards further readings or key players, but also to assist in orienting in the written discourse and act as sounding boards for ideas and interpretations.

During the first trip, on-site visits included a banquet at the Four Seasons Hotel featuring a venture capitalist speaker, one press conference at the Ontario Legislative Building and one at Toronto City Hall, one community meeting, and exhibitions held at SL's office and exhibition space, The 307. Quayside was a subject at all of these venues. Like Kenis (2019, p. 836), Carr "was an active participant amongst the other participants, taking part in meetings…while at the same time maintaining a position as a researcher." Also, tours of the Port Lands were taken with local residents. Methodologically, these tours served as a kind of "walking interview [that] have been demonstrated as a highly productive way of accessing a local community's connections to their surrounding environment. This is critical because [they reveal] people's relationships with place keys into contemporary policy issues" (Evans & Jones, 2011, p. 856).

During the second trip, two further informal conversations were held with scholarly experts, and two additional professional tours were taken, one with an urban planner and one formal tour with on-site industry. Around 20 invitations to participate in a research interview were sent to real estate developers, City officials, WT representatives, SL, journalists, activists, real estate developers and business owners in the Port Lands. Four

recorded conversations were held: one with a journalist following the story, one with a representative of SL, one with a Canadian business executive and one with a community facilitation agency. These served to drill down even further into the various discursive spheres. The low response rate, i.e., from local officials (the City, WT) was possibly reflective of the case: While Quayside was receiving widespread international attention, it was highly sensitive locally and some were hesitant to speak on record. Indeed, not a single person from Toronto City Hall or WT responded to requests for an interview. Real estate developers were equally unresponsive. Two activists also declined an interview citing their precarious labour situation and perceiving research processes as extractive.

4. A New Phase in Waterfront Development

4.1. A Short History

Toronto urban planning and waterfront development has been the subject of international scholarly debates in urban studies for decades and there is a rich literature to draw upon (see Desfor & Laidley, 2011). Indeed, the waterfront has been settled, stolen, bought, sold, drained, dredged, filled, polluted, cleaned-up, channelled, industrialized, abandoned, re-naturalized, festivalized, and reshaped continuously since its first surveying and use as a military fort by the Lieutenant Governor of Upper Canada, in 1793, and has always been an important cornerstone of Toronto's urban development. Throughout the late 19th and 20th century, the waterfront was characterized by technological innovations brought on by industrialization. In the early 1900s, with profits to be earned by turning Toronto into a booming port city along the St. Lawrence Seaway (Desfor & Laidley, 2011), the federal government took control of the lakeside lands and formed the Toronto Harbour Commission (THC) that encouraged shipping and railway development in order to transform the harbour into a bustling port moving people and goods, and enable economic growth (Desfor & Laidley, 2011).

When industry declined in the latter decades of the 20th century, politicians from all levels of government sought to transform the waterfront for new residential, entertainment, and tourism activities (Lehrer & Laidley, 2008; Sanderson & Filion, 2011). Industries had closed in response to the economic transformation, railways were dismantled, the St Lawrence Neighbourhood was built, and most recently, condominium towers were constructed that brought hundreds of thousands of new residents to the area. This post-industrial phase can hardly be captured in a single article. It has, however, been the subject of many scholarly investigations such as those from Bunce (2009, 2019), Desfor and Keil (2004), Keil and Desfor (2010), Kipfer and Keil (2002), Laidley (2007), and Lehrer, Keil, and Kipfer (2010), who recognized these revitalization plans as modes of ecological modernization, state-led green gentrification, globalization, and associated effects of urban inequality and exclusion.

This late 20th century transition was also marked by new struggles between the federal, provincial, and municipal governments, each of which wanted their stake in the waterfront. Desfor and Laidley's (2011) volume is a rich resource of details on these institutional changes. The point here is that the waterfront can be understood as a struggle of multi-level governance (Hooghe & Marks, 2001). Key institutional changes include the federal government's creation of the Royal Commission on the Future of the Toronto Waterfront (RCFTW) in 1998 to address municipal-federal tensions. Learning from the RCFTW that the THC was engaging less in port functions and more in post-industrial land use activities, the federal government decided to replace the THC by the Toronto Port Authority (TPA; Sanderson & Filion, 2011) increasing its influence. This was significant because although the THC was a federally run organization, most of its board members were appointed by the City (Sanderson & Filion, 2011); the new TPA, in contrast, consisted mainly of federal appointees (Sanderson & Filion, 2011). Also in 1998, the three levels of government established the Toronto Waterfront Revitalization Corporation (TWRC)—a body that would represent all governing interests and simultaneously "spark a 'virtuous cycle,' attracting billions in private investment from the companies and people fuelling key sectors of the global economy…creating jobs and…tax revenues" (Laidley, 2007, p. 260). The TWRC later became WT which is now in charge of property development along the waterfront (Figure 1). And, it would soon be recognized for its "almost complete lack of disclosure of the ways in which it spends public funds" (Lehrer & Laidley, 2008, p. 792).

4.2. A New Phase? The Waterfront as a Tech Hub

The development of the waterfront as the City's hub of technological development is rather recent (professional tour of the Port Lands, August 2019; professional tour of the waterfront, August 2019; tour with residents, April 2019, August, 2019). The Waterfront Innovation Centre (WIC) is already under construction. With possible synergies with George Brown College Waterfront Campus that specializes in health sciences—and is expanding its premises with a timber-frame building by Moriyama & Teshima Architects—the WIC will house more offices of MaRS (a company providing meeting, office, and lab spaces to start-ups) and the University of Toronto (U of T). MaRS and the U of T already work together supporting R&D and start-ups in fin-tech, clean tech, and health science (U of T, 2018). MaRS (2019) already boasts revenue in the billions, while the U of T boasts the forthcoming Vector Institute for Artificial Intelligence that was funded by a 100 million $Can donation by philanthropists Schwartz and Reisman (Fong, 2019). These plans to develop Toronto as a hub of state-of-the-art technological

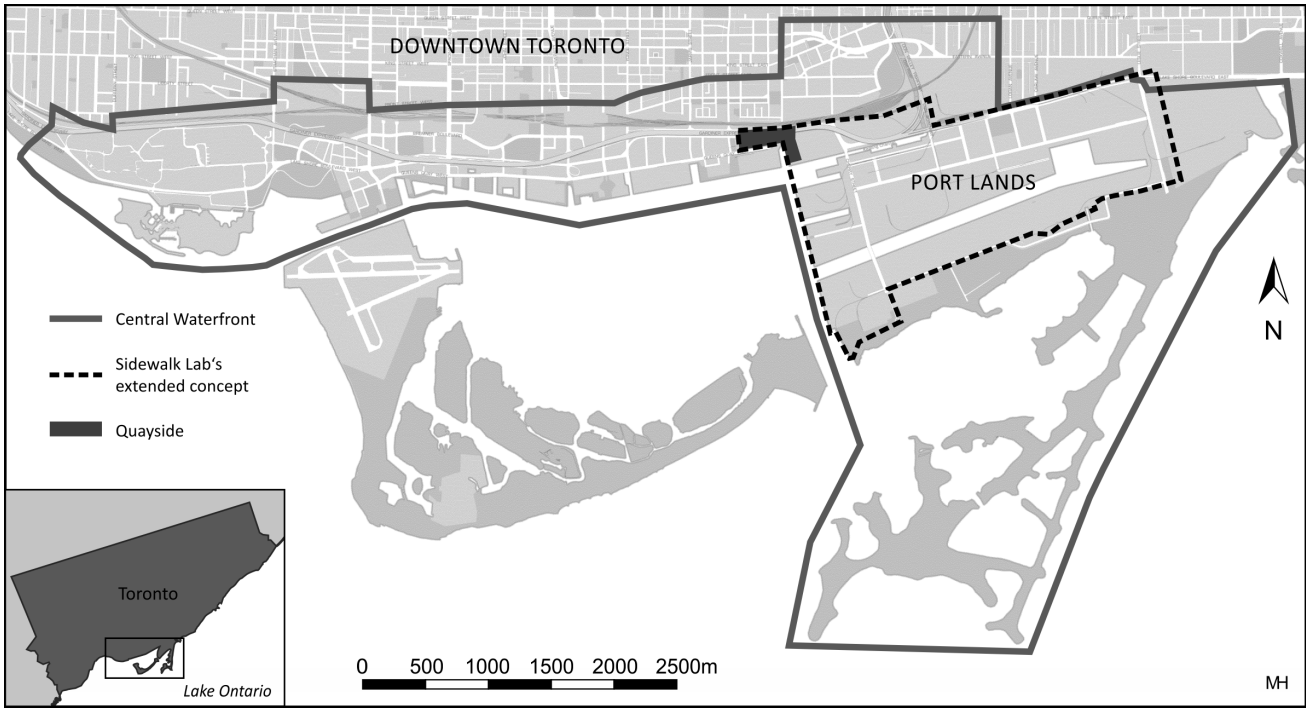

Figure 1. Downtown Toronto waterfront (map by Malte Helfer, 2019).

development are also part of wider plans to expand the knowledge economy (see Moos, Revington, Wilkin, & Andrey, 2019). SL foresees its role at Quayside as an incubator for further innovation and technological development on the waterfront (interview with business executive, September 2019; interview with community facilitator, August 2019; interview with journalist, April 2019; interview with representative from SL, August 2019).

5. Quayside Exposing Fractures across Politics and the Political

While the production of the waterfront knowledge economy—with SL at the helm—signals a new generation of waterfront development, it unfolds in the context of Toronto's pre-existing modes of urban planning (interview with community facilitator, August 2019; interview with journalist, April 2019; professional tour of the Port Lands, August 2019). This article demonstrates the post-political character of this process, discussing it in regards to: (1) SL and its alignment with Canadian politics; and (2) the possibilities and limitations of a political civic response.

5.1. SL and the Alignment of Canadian Politics

Figure 2 illustrates the key dates and publications surrounding the procurement of SL. In the spring of 2017, WT issued a Request for Proposals (RFP) and held an international competition for an "innovation and funding partner" (WT, 2017a, p. 6) at Quayside. In September 2017, the City of Toronto and WT (2017) published the Port Lands Planning Framework (PLPF). This document makes no reference to SL, but does mention (City of Toronto & WT, 2017, p. ii) that the planning concepts contained within it were the result of a collaborative process between the City, WT, and a number of consulting firms including Archaeological Services Inc., CH2MHill, Cicada Design Inc., Dillon Consulting Ltd., Golder Associates, Hemson Consulting, LURA, Performance Publications Media Group, R.E Millward & Associates Ltd., and Urban Strategies Inc. Closer inspection of these companies reveals that some of their employees now work at SL. The same month, WT notified SL that they were "the preferred proponent" (WT, 2019a). WT approved the Framework Agreement (FA; WT, 2017b) on October 17, 2017 (WT, 2019a), and on October 18, 2017, a joint public announcement was made by the Prime Minister, the Premier of Ontario, the Mayor of Toronto, and the CEOs of WT, SL, and Alphabet Inc. (Valverde, 2018; WT, 2019a). It was also noted that such an event would take careful coordination:

> I just know, as a journalist, that to get someone like Eric Schmidt and Justin Trudeau on the same stage at the same time is a difficult thing to do. So, you need to have people who can really stage manage and have close connections. (interview with journalist, April 2019)

This was followed by SL's (2017) widely marketed claims that it would develop Quayside into the best digital city ever: It would be "the first neighbourhood from the internet up" (SL, 2017, p. 20). SL claimed that Quayside would be fashioned with environmentally friendly, climate positive buildings, which would be flexible and multi-

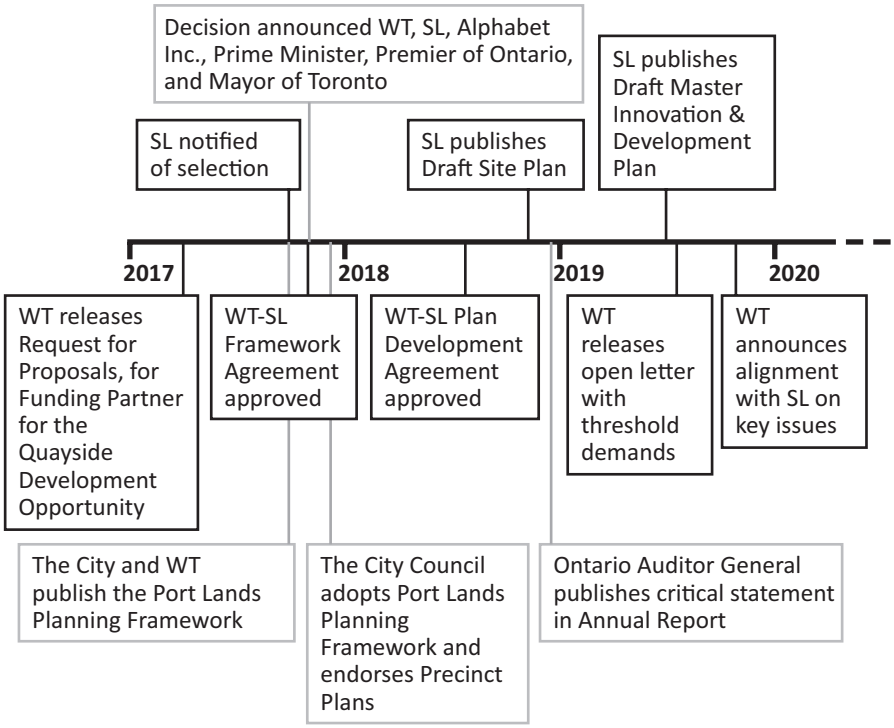

Figure 2. Timeline of key dates and publications concerning the procurement of SL.

purpose. Garbage would be automatically removed, autonomous vehicles would move people around, and sensors would monitor air pollution. Quayside would aid in economic development, by reducing the costs of government administration, and it would be equitable, ensuring that housing is affordable. The proposal was presented as historic.

In December 2017, the Toronto City Council adopted the PLPF (City of Toronto, 2019a) and endorsed the precinct plans for Polson Quay, McCleary District, South River, and Villier's Island (sub-districts of the Port Lands). These were consistent with the Official City Plan (OCP) that viewed the Port Lands as "ripe for major growth" (City of Toronto, 2019b, p. 4). Flynn and Valverde (2019) note that this is the binding precinct city plan for the Port Lands district. Generally, in Ontario, land use follows a multi-level governance set of land use planning procedures. The City sets its vision of development, assigns land uses, sets the infrastructural framework (e.g., roads, waste management), and outlines these in its OCP "the most important document for planning practice in contemporary Toronto" (Lehrer & Wieditz, 2009, p. 92). The Ontario Planning Act (Government of Ontario, 2019), however, guarantees that the Province can intervene in affairs that constitute one of their 19 domains of "provincial interest" that are expressed in very broad terms, such as the protection of natural resources, supply of infrastructure, sustainability, or climate change. The Ontario government thus has a strong authority over the municipalities. This can be traced back to the British North America Act of 1867 (that established the Dominion of Canada) and the Canadian Constitution of 1982, which gave jurisdiction to the provinces to create new municipal institutions or redraw municipal boundaries without the consent of the municipalities themselves (Frisken, 2003).

The province has intervened numerous times to change Toronto's governing structure, such as the amalgamation of the City in 1998 (Frisken, 2003) and the reduction of the City Council in 2019 (Rider & Kopun, 2019). This right to intervene remains a significant authority in the story of Quayside. While the City has planning authority and the federal government defends its national interest, the Premier of Ontario reserves a critical stance concerning Quayside (Gray & Moore, 2019; interview with journalist, April 2019).

While WT and the City were generating land use plans, SL moved forward with town hall meetings and public round tables. On July 31st, SL and WT (2018) replaced the FA with the Plan Development Agreement (PDA), which Flynn and Valverde (2019, p. 773) described as "a 'plan to plan' with no binding authority over what happens in the 12-acre Quayside area." The PDA did, however, bind the SL to a 50 million US$ investment into public outreach programs towards the development of its Master Innovation and Development Plan (MIDP) (SL & WT, 2018, p. 9). As stated in the PDA (SL & WT, 2018, p. 53), these were design jams, civic labs, neighbourhood meetings, use of social media, and public roundtables. SL also offered space for weekend Open Houses in its offices at The 307. There, visitors could observe models, engage with interactive programs explaining urban design, learn about the housing objectives and the benefits of digital electricity or timber-

frame architecture. Outside The 307, visitors could learn about weather-mitigating building raincoats and hexagonal cobblestones with traffic controlling sensors (tour of The 307, April 2019, August 2019).

While SL's efforts in public outreach seemed impressive compared with business-as-usual developer-led urban planning (interview with community facilitator, August 2019), it all had the veneer of a sales pitch. Most messages praised how fabulous Toronto was, and how SL's products would only improve it. As Coletta (2019) later quoted Michael Bryant from the Canadian Civil Liberties Association (CCLA), people were "seduced by the honey pot of Google's sparkling brand and promises of political and economic glory."

Finally, in June 2019, SL released the 1,500-page, 4-volume, MIDP. It could be read on-site at The 307 or downloaded from SL's website, but hard copies were not available for order (tour of The 307, August 2019). It received considerable critique for being impossible to digest by the public (Valverde & Flynn, 2019): "The MIDP is not for reading," Haggart (2019) commented. The MIDP also indicated that SL wanted to develop much more than the originally announced Quayside. Effectively, SL wanted to build not a 4.9-hectare but a 77-hectare Innovative Development and Economic Acceleration District (SL, 2019a, 2019b) on municipal precincts south and southeast of the Quayside property, including Google's Canadian headquarters on Villier's Island (SL, 2019a, p. 20).

By mid-2018, however, the Quayside project was rather contested locally, and the MIDP, its bulk, and the variety of surprises and unanswered questions, did not quell the critical reaction. WT (2019a) produced a "Note to the Reader" in what seemed like a feeble attempt to assist the interested public in making sense of the MIDP. Later, the new WT Board Chair, surprised observers with an open letter to the public, acknowledging that the MIDP included "a number of exciting ideas that respond to challenges," but distancing itself from SL because there would be "very different perspectives" such as the massive expansion beyond the Quayside area (Diamond, 2019). The Chair also concluded that the project had "stirred vigorous debate and, regardless of the outcome, raises issues to consider." It was a profound distancing of a public agency from a planning proposal of which itself was, in fact, in charge. WT then set an October 31, 2019 deadline for SL to respond to unanswered questions. By early November 2019, WT (2019b, p. 1) declared that it had found "alignment with SL on the threshold issues [and that] WT's Board of Directors unanimously decided to move forward with the formal evaluation of the MIDP" in consultation with their experts, who include ARUP, Moriyama & Teshima Architects, Perkins & Will Architects, Steer Davies & Gleave Ltd., N. Barry Lyon Consultants Limited, and McCarthy Tétrault (WT, 2019c). Several of these agencies are already active in other projects on the waterfront.

5.2. The Political Civic Response

Various authors have described the controversies around Quayside (Flynn & Valverde, 2019; Haggart, 2019; Tusikov, 2019a, 2019b; Valverde, 2018; Wylie, 2018). The current civic reaction spans two polar opposites, from fully against to fully in favour (interview with community facilitator, August 2019). The latter are consistently members or associates of SL such as Urban Strategies Inc. or the Wellesley Institute (Berridge, 2019; Doctoroff, 2019; McKenzie, 2019). These argued that people should not fear private companies, and that Torontonians ought to seize the opportunity to improve the labour market and foster economic growth. The Port Lands, according to these authors, would be a hub of innovation and economic activity that would place Toronto at the forefront of technological innovation (Florida, 2019). Voices in the middle ground are in favour as long as questions are answered and SL is accountable to the public (interview with community facilitator, August 2019).

Voices against Quayside began surfacing in early 2018. There were resignations and dismissals at WT, and the CCLA filed a legal suit against WT and all three levels of government arguing that the contractual agreements with Alphabet Inc. on data governance were neither in the public interest nor constitutional (interview with business executive, September 2019; press conference at the Ontario Legislative Building, April 2019). Later, former Toronto Chief Urban Planner came out with the criticism that the plans offer no real solution to the housing crisis (Keesmaat, 2019). Similarly, another City Councillor spoke out against it, arguing that privately developed cities cannot substitute democracy (Perks, 2019).

#Blocksidewalk was also launched as an informal group of concerned residents, City Councillors, local urban scholars, tech entrepreneurs, and city planners (press conference at Toronto City Hall, April 2019). It became one of the more vocal opponents of SL, with the public interest as a key concern: "Development should prioritize city needs first, not the needs and interests of a private corporation" (Blocksidewalk, 2019). The key points of dispute are summarized in Table 1. The recurring themes are data governance, the problems of "rogue capitalism" as inspired by Zuboff (2019), lack of transparency, trust, scale, political economic disparity, tax avoidance, housing affordability, spatial planning, labour market, public services, and economic nationalism.

While wide in their scope, the source of the critiques focussed mainly on SL's digital city concept and associated array of digital services, which would require developed surveillance infrastructure throughout the development—including inside private quarters—to observe, and capitalize on, human behaviour (banquet at the Four Seasons Hotel, April 2019; interview with business executive, September 2019). SL attempted to quell these concerns, and proposed a set of icons that would indicate to users what kind of information they were col-

Table 1. Key points of criticism concerning the Quayside project. Source: Blocksidewalk (2019).

Codes	Quotes from #Blocksidewalk (2019)
data governance, rogue capitalism, public interest	"Toronto [needs] digital governance practices that will serve the public interest. [These] should [be] in place before committing to a partnership whose consequences we can't control."
data governance, public interest	"There is no option for residents, workers or visitors to opt out of 'urban data' collection, and no safeguards for children….All Torontonians deserve the right to say no to ubiquitous surveillance."
lack of transparency, trust, public interest	"The project was [first] limited to a 12-acre area….Then, a leaked document revealed that they planned…450 acres….Now…they want 190 acres. SL isn't…clear about their intentions. Can they be trusted with our waterfront?"
scale, political economic disparity, public interest	"As residents, we can't compete with SL's enormous lobbying budget."
tax avoidance, public interest	"Google's affiliates demand tax breaks for private real estate developments on top of avoiding corporate taxes…global tech companies should pay their taxes, not profit from ours."
housing affordability, spatial planning, public interest	"Large tech developments drive up rents….Let's learn from the mistakes of San Francisco, Seattle and New York City, where the cost of renting a home has outpaced even tech workers' salaries. Toronto needs a real affordable housing strategy. This isn't it."
labour market, public interest	"More than half of Google's global workforce is temporary or contract-based, which means they earn less money and have no job security. [Furthermore], automation [may] threaten good public sector jobs."
data governance, public services, public interest, economic nationalism	"SL wants to use surveillance technologies to change how Torontonians receive health care….There are billions of dollars in profits to be made in health data and AI. We support universal health care and think that American tech companies have no business running our public health system."
data governance	"Surveillance practices actually harm low-income…and disabled people…vulnerable to algorithmic bias."

lecting. They also argued that on-site cameras would de-identify data, decoupling collected data from personally identifying data; however, not everyone was convinced (Haggart, 2019; Tusikov, 2019a, 2019b; Wylie, 2018).

#Blocksidewalk's concerns also targeted Alphabet's known business model, and lack of clarity on issues of data storage and ownership. Venture capitalist Roger McNamee condemned Google's behavioural prediction algorithms designed to steer behaviour to benefit their business (banquet at the Four Seasons Hotel, April 2019). Harvard Professor Shoshanna Zuboff along with Roger McNamee and Jim Balsillie, founder of the Balsillie School of International Affairs, testified as witnesses before the Canadian Standing Committee on Access to Information, Privacy and Ethics, as well as the International Grand Committee on Big Data Privacy and Democracy, with critical comments on Alphabet Inc.'s business model. Echoing these:

> The fact that you would let a company such as Google control your city data, data driven economy….You know, all the alarms went off in my head. And, I thought it was incredibly irresponsible on the part of the political leaders…to dive into something so naively with a powerful company, whose objective is to undermine personal autonomy and sell that to the highest bidder….It was an incredibly naive….When it comes to data, the consumer of your data is another corporation who is trading personal autonomy at the corporate level. So, there is no consumer in this anymore; it's just business to another business. And, once we lose personal autonomy, that's it for democracy, and that's it for markets. So it's a much more….It's a higher stakes game right now, because its irreversible. (interview with business executive, September 2019)

These critical voices are either direct supporters of, or inspirations to, the #Blocksidewalk campaign. To date, #Blocksidewalk has over 1,000 members (Blocksidewalk, 2019), amassing a formidable force against the project, and mobilizing the public to address the deeper implications (interview with community facilitator, 2019). They have regular public meetings and are active in social media. #Blocksidewalk, the CCLA lawsuit, and a few prominent experts appear to be the main oppositional forces. "I think they are going to be shown the door," said one interviewee (interview with business executive, September 2019).

6. Conclusion

Quayside represents the unprecedented case of a large-scale digital corporation entering the field of urban planning, and aiming to control development over a piece of urban space for its own business purposes. Amazon.com has gained a reputation for its urban–regional imprint that results from their parallel worlds of digital, logistical, and locational operations (Hesse, 2018). Also, in his striking account of San Francisco and Bay Area, Walker (2019) sketched, in broad terms, the long-term impacts that big tech firms can have on urban–regional lifeworlds. The case of Quayside, however, delivers important insights about how public institutions respond to new large corporate players in the field, and how modes of urban governance and planning are affected. Quayside illuminates challenges in urban planning and the kinds of relationships that unfold. We argue that these relationships are largely post-political, but that there is also the glimmer of a possible return of the political.

6.1. Lessons for Urban Planning

There are three issues to which urban planning will need to respond to if—or when—big tech corporations enter the field of urban development. The first is an area-based concern: Quayside is unfolding amidst a new phase in Toronto's waterfront development, namely as a location for an expanded knowledge economy. These are processes, too, that are closely connected to post-industrial modes of development that prioritized globalization, privatized condominiums, state-led green gentrification, and mega-event planning (Bellas & Oliver, 2016; Bunce, 2019; Desfor & Keil, 2004; Desfor & Laidley, 2011; Keil & Addie, 2016; Kipfer & Keil, 2002; Lehrer & Laidley, 2008; Moos et al., 2019; Rosen & Walks, 2014). Alphabet Inc., as another developer on the field, demonstrated that the trajectory of a neoliberal, market-driven land use, speculation, and investment remains unchanged.

The second concerns the business model that more and more big tech firms operate with. Much of the critique against SL—whether in the form of #Blocksidewalk, the CCLA lawsuit, outspoken venture capitalists, or observant scholars such as Haggart (2019), Tusikov (2019a, 2019b), or Wylie (2018)—concerned data collection, surveillance, the relationship between it and marketable predictive algorithms, and the inability of legislation to protect citizen rights. There were also concerns about SL's willingness to respond to public problems in housing, transportation, labour market, and delivery of public services and prioritize them over their profit-making strategies. SL's Quayside demonstrated that its business model and vision of urban development does not prioritize the public interest.

Third, Quayside exposed how municipalities and their residents are vulnerable to the manoeuvrings of large corporations. SL, the daughter firm of one of the largest tech companies in the world, aimed at taking over planning functions normally left to municipal institutions, such as staging town hall meetings, or the MIDP that was disguised as, but not a replacement for—as it took Flynn and Valverde (2019) to point out—a planning document. As Flynn and Valverde (2019, p. 774) further argue:

> This case…calls into question the degree to which smart city pioneers like SL, who have a tremendous amount of lobbying power and funding, make a play not only for more data or more money, but for the power to plan public space.

Alphabet Inc. exercised considerable pressure on local governing institutions. Municipalities elsewhere thus need to ask themselves if they have the sufficient resources to adequately respond to large tech firms in ways that will protect their citizens' rights and the integrity of their institutions.

6.2. Lessons for Scholarly Debate

Several scholars have already come to the conclusion that Toronto's waterfront development is post-political (Bellas & Oliver, 2016; Keil & Addie, 2016; MacLeod, 2011; Rosen & Walks, 2014). So far, Alphabet Inc. has demonstrated that it operates within this governance mode, and that the gap between politics and the political is unlikely to be narrowed by their activity in the urban planning scene.

First, post-politics is characterised by the reduction of political contradictions to policy problems and managerial processes (Wilson & Swyngedouw, 2014). This was the case at Quayside as SL and the Canadian government (politics), together, aimed at neutralising urban planning practices. The procurement and endorsement of SL at Quayside was the outcome of networks of private firms, WT, and the federal government. WT orchestrated the RFP process in coordination with all three levels of government and a network of planning consulting firms. The timeline of events and publications shows, too, how SL and Canadian politics were in co-operation with one another. That is, the urban planning agenda was set by politics through means that were neither transparent nor steered by urban policy, planning, or public need.

Second, post-political managerial processes are legitimated through a mirage of participatory processes where the scope of possible outcomes is narrowly defined (Wilson & Swyngedouw, 2014). After SL was chosen, it held information sessions in the form of town hall meetings and civic jams, etc. These were glossy events with high profile names/speakers where SL set the agenda, choose speakers, and curated its audience. On one hand, these events served as a means of delivering information to residents—but not to seek out what was necessary or in demand. On the other hand, they also served to groom SL's image as a competent, expert player in the field of urban development. Also characteristic of the process was how information was communi-

cated at a volume that was crippling for the public to digest. Despite public messages articulated by prominent voices, or the activity of groups like #Blocksidewalk, SL's only response to criticism was either silence or the production of inaccessible planning documents. In sum, the memory of deliberation was repeatedly invoked—this is post-political in the Symbolic (Wilson & Swyngedouw, 2014)—yet SL's efforts consistently offered neither space for public debate or contestation, nor a guarantee for the inclusion of a diversity of voices.

Alphabet Inc. continually strived for a hegemony in Toronto's urban planning discourse, which endorsed the split between politics and the political that others have already identified as characteristic of Toronto's urban development (Keil & Addie, 2016; MacLeod, 2011; Rosen & Walks, 2014). However, a chorus of independent political civic action groups did arise, raising awareness about the potential negative impacts of SL and Quayside. As Legacy et al. (2018) also observed in their work, this action took place in spaces outside formal planning. It was #Blocksidewalk, prominent venture capitalists, and the CCLA that raised "fundamental questions about the future of cities,…the allocation of resources, or the distribution of goods and services" (Legacy et al., 2018). So, while Toronto's waterfront development as a hub in technological innovation is unfolding as an exercise of politics, perhaps there is a glimmer of *realpolitik*, as these groups filled the discursive void by raising pointed concerns that were left unaddressed. Perhaps they marked a return to the political that cannot be "written off" (Kern & McLean, 2017, p. 410).

When one of the big tech corporations enters the field of real estate and land use development, it may mark a new generation of post-political cities. If Quayside is any indication, such cities will be run as a coalition of big politics that do not respond to the public interest or need, but to the business and profit-making interests of politics. A civic political response is, however, still possible. Will the post-political gap close? Look further to Quayside to find out.

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Conflict of Interests

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About the Authors

Constance Carr is a Senior Post-Doctoral Researcher at the University of Luxembourg, a Visiting Scholar at the CITY Institute, York University, and Adjunct Faculty at Sciences Po. Much of her research focussed on policy and planning practices in urban regions under growth pressure and critical takes on sustainable urban development. She has published in *Regional Studies*, *Planning Theory & Practice*, *European Planning Studies*, *Journal of Transport Geography*, and *Environment and Planning C*: *Politics and Space*.

Markus Hesse is Professor of Urban Studies at the University of Luxembourg, with an academic background in geography and spatial planning. His research interests focus on the intersections of urban development, economic geography and metropolitan governance. A recent research project explored the rise of relational cities, or better, 'city-state formations,' in Europe and South East Asia, namely Geneva (Switzerland), Luxembourg (Luxembourg), and Singapore. Also, some emphasis is placed on the science–policy interface in urban planning and governance.

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Article

Googling the City: In Search of the Public Interest on Toronto's 'Smart' Waterfront

Kevin Morgan and Brian Webb *

Geography and Planning, Cardiff University, Cardiff, CF10 3AT, UK; E-Mails: morgankj@cardiff.ac.uk (K.M), webbb1@cardiff.ac.uk (B.W.)

* Corresponding author

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Abstract
Toronto's Quayside waterfront regeneration project has become an international reference point for the burgeoning debate about the scope and limits of the digitally enabled 'smart city' narrative. The project signals the entry of a Google affiliate into the realm of 'smart urbanism' in the most dramatic fashion imaginable, by allowing them to potentially realise their long-running dream for "someone to give us a city and put us in charge." This article aims to understand this on-going 'smart city' experiment through an exploration of the ways in which 'techno-centric' narratives and proposed 'disruptive' urban innovations are being contested by the city's civic society. To do this, the article traces the origins and evolution of the partnership between Waterfront Toronto and Sidewalk Labs and identifies the key issues that have exercised local critics of the plan, including the public/private balance of power, governance, and the planning process. Despite more citizen-centric efforts, there remains a need for appropriate advocates to protect and promote the wider public interest to moderate the tensions that exist between techno-centric and citizen-centric dimensions of smart cities.

Keywords
Google; public interest; Quayside; Sidewalk Labs; smart city; smart urbanism; Toronto; urban planning

Issue
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1. Introduction

The unprepossessing landscape of Toronto's post-industrial waterfront has become the unlikely setting for what is arguably the boldest and most ambitious 'smart city' design ever to emerge in North America. Far from being a purely local matter, the proposed regeneration of the Quayside area of the waterfront is already a national and international reference point for the burgeoning debate about the scope and limits of the digitally enabled 'smart city' narrative (Shieber, 2019; Skok, 2019; Wakefield, 2019; Won, 2018). Indeed, the debate in Toronto embraces many of the themes that have surfaced elsewhere under the 'smart city' moniker, such as techno-centric versus citizen-centric perspectives on urban innovation (Cardullo & Kitchin, 2019), data governance issues around privacy and security (Kitchin, 2016; van Zoonen, 2016), the extent to which 'smart urbanism' fosters or frustrates urban sustainability (Cugurollo, 2018; Haarstad, 2017), the integrity of the public sphere, where governments are expected to exercise a duty of care (Rodríguez Bolívar, 2016), and the role of profit-seeking technology vendors that are marketing their wares to city mayors as panaceas for a wide array of urban planning problems (Viitanen & Kingston, 2014; Wiig, 2015).

But why does a local regeneration project have such global resonance? The main reason it resonates is because of the corporate identity of the designer—Sidewalk Labs (SL). SL is an affiliate of Google and both

are subsidiaries of Alphabet, the parent company. The Quayside project signals the entry of a Google affiliate into the realm of 'smart urbanism,' as yet another 'corporate storyteller' (Söderström, Paasche, & Klauser, 2014), in the most dramatic fashion imaginable. While most big tech vendors are content to supply various combinations of technology and services (McNeill, 2015), SL sees the waterfront as an opportunity to engage in a unique place-making experiment that would marry digital technology with urban design and physical planning like never before (Pandey & Soto, 2019). This was evident from the public announcement of the project, when Eric Schmidt, Google's former executive chair, said that the project allowed them to realise their long-running dream for "someone to give us a city and put us in charge" (Balsillie, 2018, para. 2).

The aim of this article is to analyse SL's attempt to develop and control the narrative behind this 'smart city' experiment and identify the extent to which the public interest is employed by various actors within the planning process as a means of countering private interests. It does this by first situating the Toronto case in the literature on 'smart urbanism' and the 'public interest' to highlight the critical perspectives of urban scholars in Section 2. Section 3 examines the origins and evolution of the partnership between Waterfront Toronto and SL. Section 4 identifies the key issues that have exercised local critics of the plan, such as the public/private balance of power, the role of civil society, and the planning process. Ultimately, we argue that despite more citizen-centric efforts, there remains a need for appropriate advocates to protect and promote the wider public interest as the smart city emerges as a means to moderate the tensions that exist between techno-centric and citizen-centric dimensions of smart cities.

2. Smart City Narratives: Critical Perspectives on Smart Urbanism

Urban scholars have spent more than a decade debating the nature of the 'smart city' and many of them have concluded that it is virtually impossible to understand it in the abstract because it assumes so many diverse forms in practice, prompting one scholar to call for 'the real smart city' to stand up (Hollands, 2008). But the fact of the matter is that, given these manifold forms, there is no such thing as the 'real' smart city. What we have instead is a wide array of smart city narratives, many of which are techno-centric narratives, with a growing minority concerned to explore more sustainable or progressive narratives. Before addressing these thematic narratives we need to appreciate what is arguably the most significant aspect of all smart city narratives—namely the 'smart' discourse (Joss, Sengers, Schraven, Caprotti, & Dayot, 2019).

Consciously or not, the 'smart city' discourse frames concepts, policies and investment strategies because it informs and fashions the cognitive maps that constitute dynamic, innovative and well-managed cities. Indeed, some scholars now claim that the smart city can be considered a global discourse network (Joss et al., 2019). This claim is based on a webometric analysis of ten smart city dimensions that generated a cluster of more than two dozen widely cited cities, a group that included all the cities listed in the top ten smart cities on the planet, namely Vienna, Toronto, Paris, NYC, London, Tokyo, Berlin, Copenhagen, Hong Kong and Barcelona (Cohen, 2012). The conclusions of the webometric analysis were twofold. Firstly, that:

> It is no coincidence that the 27 cities identified here form the core of the global discourse network. As (mostly) capital and world cities, backed by national governments and promoted by international organizations and business, they have evidently seized the opportunity to place themselves at the heart of the evolving smart city agenda, using it concurrently to promote urban renewal to their domestic audiences and to signal their global ambitions to foreign audiences, and in doing so frequently engaging in mutual cross-referencing. (Joss et al., 2019, p. 23)

Secondly, the authors detect a complex shift in the discourse regime as regards urban governance inasmuch as it:

> Entails calls for a disruptive (seen as positive) change of society: references to outmoded twentieth-century governance models, the need for fundamental transformation, even a whole new way of thinking etc., together make clear the smart city's ambition to reach profoundly into the social realm. (Joss et al., 2019, p. 23)

Although we can debate the merits of the webometric methodology, these two conclusions deserve to be taken seriously because (a) a group of prominent cities are clearly being touted as beacons for all other cities to emulate in the spurious name of 'global best practice,' and (b) the socially 'disruptive' ambitions of smart city discourse are far from being wholly benign as we will see in Toronto. Already we can identify examples of global interest by government in smart cities, from the European Commission's Smart City Solutions (GrowSmarter, 2015), India's Smart City Mission (Ministry of Urban Development, 2017), to the UK Future Cities Initiative (TSB, 2012), and the United States' Smart City Challenge (US Department of Transportation, n.d.). Yet we can also detect where the enthusiasm for these sorts of smart city initiatives has resulted in more variegated impacts on the ground where, business interests have been prioritised (Grossi & Pianezzi, 2017), smart city governance has undermined more local democratically elected bodies (Praharaj, Han, & Hawken, 2018), and national programmes have emphasised external export opportunities rather than improvements to cities (Buck & While, 2017).

At the core of most smart city narratives is a paean to the formidable technical power of Information and Communications Technologies (ICTs). Like all technologies, it is a technical power that has no pre-ordained social and spatial trajectory because it is contingent on how and in whose interests it is deployed. But if the early deployment of ICT is any guide, the impact of smart urbanism could be both socially and spatially uneven (Graham & Marvin, 2001; Moss, 1987; Morgan, 1992). Because long before smart city narratives emerged, urban scholars like Mitchell Moss were among the first to explore the implications of ICT for the spaces and flows of urban life. In a celebrated analysis he correctly identified that the diffusion of ICTs would lead not to the 'end of agglomeration' or the 'death of distance' as some technophiles were predicting but, rather, to the bifurcation of space as advanced business services were centralized in a few principal world cities, "while simultaneously leading to the dispersion of routine information-based activities to the periphery of the metropolitan regions surrounding the largest central cities" (Moss, 1987, pp. 534–546).

Notwithstanding these critical findings, the vast majority of smart city narratives have been so enthralled by the technological possibilities of digitally-connected urban infrastructures and data-driven services that they constitute a form of techno-utopianism (Söderström et al., 2014; Wiig, 2015). As these scholars have demonstrated, this techno-centric discourse owes a great deal to the highly successful marketing campaign that IBM launched after 2008. Having developed its smart city concept through consultancy work in Masdar City and Rio de Janeiro, IBM sought to market the idea more broadly through a challenge exercise, the Smarter Cities Challenge. IBM announced the challenge in 2010 and chose the first round of 24 cities later that year, though the company was slow to realise that the main attraction for the cities was as much IBM's corporate imprimatur as its smart city technology. When asked why cities applied to the Smarter Cities Challenge, the IBM Director said:

> [The Smarter Cities Challenge] generated huge interest from cities all over the world, *even though we hadn't really begun to explain what the business case was for these things, what the return on investment was going to be, how much money could we help you save….It took us a long time to understand that what was really driving this sort of thing is economic development*. (Wiig, 2015, p. 262; italics in original)

In other words, cities were using the IBM challenge as a place-marketing exercise to signal to international investors that, despite the economic downturn, they remained 'open for business' (Wiig, 2015).

If techno-centric narratives dominated the first wave of smart city discourse, recent years have witnessed a new wave of critical perspectives that aim to explore more progressive citizen-centric narratives. Drawing on the work of some of the early critics (e.g., Graham & Marvin, 2001; Hollands, 2008), Vanolo summarises the concerns of many critical scholars when he argued that "the smart city discourse distances urban government from politics and represents the urban question in terms of the environment and technology, broadening the field of action of technicians, consultants and private companies" (Vanolo, 2013, p. 883). Two dangers flow from such a discourse. Firstly, the techno-centric discourse presents itself as 'natural' and 'univocal' and effectively seeks to de-politicize the urban planning agenda. Secondly, a single techno-centric vision of the city of the future restricts the horizon of any imaginative planning options, foreclosing the debate about "alternative solutions to the problems of today and tomorrow" (Vanolo, 2013, p. 894).

The new wave of critical perspectives provides a belated opportunity for robust debate about the scope and limits of smart urbanism and its potential for fostering or frustrating urban wellbeing. The critical scholars of this new wave are addressing issues that have been elided hitherto, like the need to overcome the tokenistic attitude to citizen engagement in smart city narratives and the necessity to give more prominence to 'the place of the public' (Joss, 2018); the need to be more alive to the ethical issues associated with the erosion of privacy through persistent and systemic mass surveillance (Kitchen, 2019); the need to be more aware of the "anti-planning" thrust of smart city experimentalism, which threatens to undermine the normative values of traditional technologies of planning (Cowley & Caprotti, 2019) and the need to confront the spurious nature of the smart city's credentials as regards social and environmental sustainability (Viitanen & Kingston, 2014). But critical scholars are also beginning to appreciate the need to move beyond pure critique to explore the scope for more progressive models of actually existing smart urbanism. The positive case was well made recently by McFarlane and Söderström, who issued the following political plea:

> We need to engage in the analysis of the variegated forms that 'real' SU [smart urbanism] takes on the ground, both in the urban policies of national governments and municipalities, and in the grass-roots initiatives and social movements that disturb, resist or create their versions of SU. (McFarlane & Söderström, 2017, p. 313)

Early smart city initiatives were rife with examples of corporate domination and rhetoric (McNeill, 2015; Paroutis, Bennett, & Heracleous, 2014; Söderström et al., 2014). Many of these developments failed to prioritise local citizen engagement as they sought to maximise the influence of their proprietary technologies within cities, such as Rio de Janeiro's smart city investments (Gaffney & Robertson, 2018). As identified in Curitiba, Brazil, smart city developments need to better engage with community and participatory forms of governance in order to improve well-being (Macke, Casagrande, Sarate, & Silva, 2018). Yet there are also later cases of smart

city developments that have prioritised local community engagement above wider corporate interests, such as Newcastle, Australia, and in doing so achieve success through the local institutionalisation of smart policies and government ownership of infrastructure (Dowling, McGuirk, & Maalsen, 2018). Similarly, Amsterdam has sought to develop its smart city strategy through "an approach closely linked to strategic urban planning principles…based on strategic thinking, collaboration, and inclusive criteria" (Mora & Bolici, 2017, p. 261) designed to ensure the broader public interest is served.

Planning has long justified its ability to intervene in the built environment on the basis of acting in the public interest (Alexander, 2002). While the profession has often debated what is meant by the concept (Campbell & Marshall, 2002; Murphy & Fox-Rogers, 2015), it is regularly invoked as a means of plan evaluation in practice (Alexander, 2002) and an ethical norm (Howe, 1994) by planners. More broadly, concepts of the public interest have extended to considerations of planning for justice (Basta, 2015; Fainstein, 2010; Schlosberg, 2013). This idea of a universal public interest has however been contested, particularly in relation to criticism of planning's technocratic rational comprehensive model and the recognition of the plurality of interests inherent within planning processes (Lindblom, 1959; Sandercock, 1998).

The rise of the entrepreneurial city in the 1990s provided further reflection for the planning profession on the role of the public interest in practice (McGuirk & MacLaran, 2001) and examination of the role of collaborative planning to address the local diversity of voices present within communities (Healey, 1997). While Healey argued that a 'common' public interest may no longer exist due to a recognition of the heterogeneity of communities she still suggested that a public interest which can "reflect the diversity of our interests" (Healey, 1997, p. 297) was possible and important so long as it was representative and discursive. Campbell and Marshall (2002, pp. 181–182) however note that "given the deep divisions of interest within society, the persistence of disagreement and the prevalence of discord and conflict it seems unlikely that a consensus can be discursively constructed" and as such "argue that choices cannot be left endlessly open." In full recognition of the need to try and represent the diversity of views, the state, and planning's central role within it, therefore often attempts to construct the public interest.

Drawing on a case study of Toronto's Quayside development we examine the process of plan-making by SL and Waterfront Toronto in relation to the public interest, both procedurally and substantively, through an examination of an extensive array of corporate and government publications, media reports, and online discussions in the public domain. Procedurally Alexander (2002, p. 234) suggests the public interest can be "effectively operationalized through socially adopted and legally enforced norms and rules of due process, sound administration, and reasonable decision-making." While substantively plans may be assessed on the extent to which they enhance "the welfare of all the parties affected by a plan's impacts" (Alexander, 2002, p. 238). Through the lens of the public interest, we aim to explore the variable disruptive effects emerging between techno-centric narratives and citizen-centric narratives of smart urbanism and the role of planning in what we believe to be the boldest smart city design ever proposed for a North American city—the SL plan for the regeneration of Toronto's waterfront.

3. Positioning Toronto's Smart City

Toronto's rise towards one of North America's largest technology hubs has been rapid. A city of 2.9 million people within a wider region of 5.9 million, CBRE, the largest commercial real estate services company in the world, proclaimed the city added twice as many new technology jobs (22,500) as San Francisco (11,540) in 2017 (CBRE, 2018). This saw the city move from 12th to 6th in the CBRE's overall annual ranking. The most recent 2019 ranking shifted the city even higher to 3rd place behind the San Francisco Bay Area and Seattle. Toronto's 54% increase in total technology occupations since 2013 was the fastest of all studied markets, nearly matching the number of technology jobs generated in the San Francisco Bay Area over the same period (CBRE, 2019). This boom in the technology sector saw many in Toronto's business community eagerly embrace a Google affiliate company's investment in the city, with the Toronto Board of Trade announcing Daniel Doctoroff, the CEO of SL, was to headline their annual dinner a week after the initial selection of the company was made while praising that SL involvement would bring the "global spotlight to our waterfront, establishing it—and Toronto—as a testbed for digital technology and urban innovation" (Toronto Board of Trade, 2017, p. 1). Urban innovations were in high demand in Toronto as its recent success brought with it a series of urban problems, making the city's population potentially more susceptible to promises of digital solutions. Between 2006 and 2016 the city developed at a brisk pace, with a 9% increase in population (Statistics Canada, 2006, 2016) alongside a high-rise residential building boom that has put pressure on city centre amenities and services (City of Toronto, 2018). This increase in development coincided with house prices doubling between 2011 and 2019 (Real Estate Bay Realty Inc, 2019), political debate hindering investments in public transport (Walks, 2015), and inequality becoming more polarised within the city (Walks, Dinca-Panaitescu, & Simone, 2016). It was within this environment that Waterfront Toronto sought a partner to develop a 4.9 hectare site on the city's industrial waterfront and SL began to develop its narrative of digital placemaking solutions for Toronto's ills.

Waterfront Toronto (previously Toronto Waterfront Revitalization Corporation until 2007) was established in 2002 as a tri-funded agency by the federal, provincial,

and municipal governments to revitalise Toronto's waterfront. Its mission was to facilitate the development of 1,149 hectares of private and public land in a coordinated manner, which it has sought to operationalise through a sustainability framework based on three pillars of economic development, social growth, and environmental protection (Bunce, 2009). The agency however lacks ownership and control over 99% of the land it is tasked to revitalise, does not have expropriation powers, and does not have zoning or planning control powers (OAG, 2018). Waterfront Toronto did however manage to gain sole ownership over a 4.9 hectare site less than 2km East of the downtown core known as 'Quayside,' a largely vacant former industrial area. With this new-found opportunity and a new CEO, Will Fleissig, at the helm, Waterfront Toronto issued a request-for-proposal (RFP) in March 2017 for "an Innovation and Funding Partner that…will help create and fund a globally-significant community that will showcase advanced technologies, building materials, sustainable practices and innovative business models that demonstrate pragmatic solutions toward climate positive urban development" (Waterfront Toronto, 2017, p. 6). Alphabet's subsidiary, SL, was the successful bidder.

Will Fleissig, who stepped down in July 2018, repeatedly referred to SL as a "partner" and the plan for Quayside as a "joint venture." One local commentator however argued that this was not the case, but in fact that he was so mesmerised by SL's smart city discourse of disruption that:

> In the name of speed and innovation, he blew off the agency's meticulously cultivated relationships with the members of the public who have been thoroughly engaged with Waterfront Toronto's work for almost a generation. (Lorinc, 2018, para. 10)

Waterfront Toronto later admitted to communicating and providing more information to SL and a few other bidders compared to other parties prior to the issuing of the RFP, and were additionally criticised by Ontario's Auditor General for the short six week time frame to respond to the call compared to previous RFPs, for not consulting with other levels of government prior to signing an initial agreement with SL, as well as a lack of time (a weekend) for the Board of Waterfront Toronto to review the initial Framework Agreement (OAG, 2018). Once signed, the scope of the project proceeded to rapidly evolve over 16 months, with the scale of the project growing from 4.9 hectares to 77 hectares to include proposals for two smart neighbourhoods situated within a wider Innovative Development and Economic Acceleration (IDEA) district (Figure 1). The proposal initially envisioned the development of the original

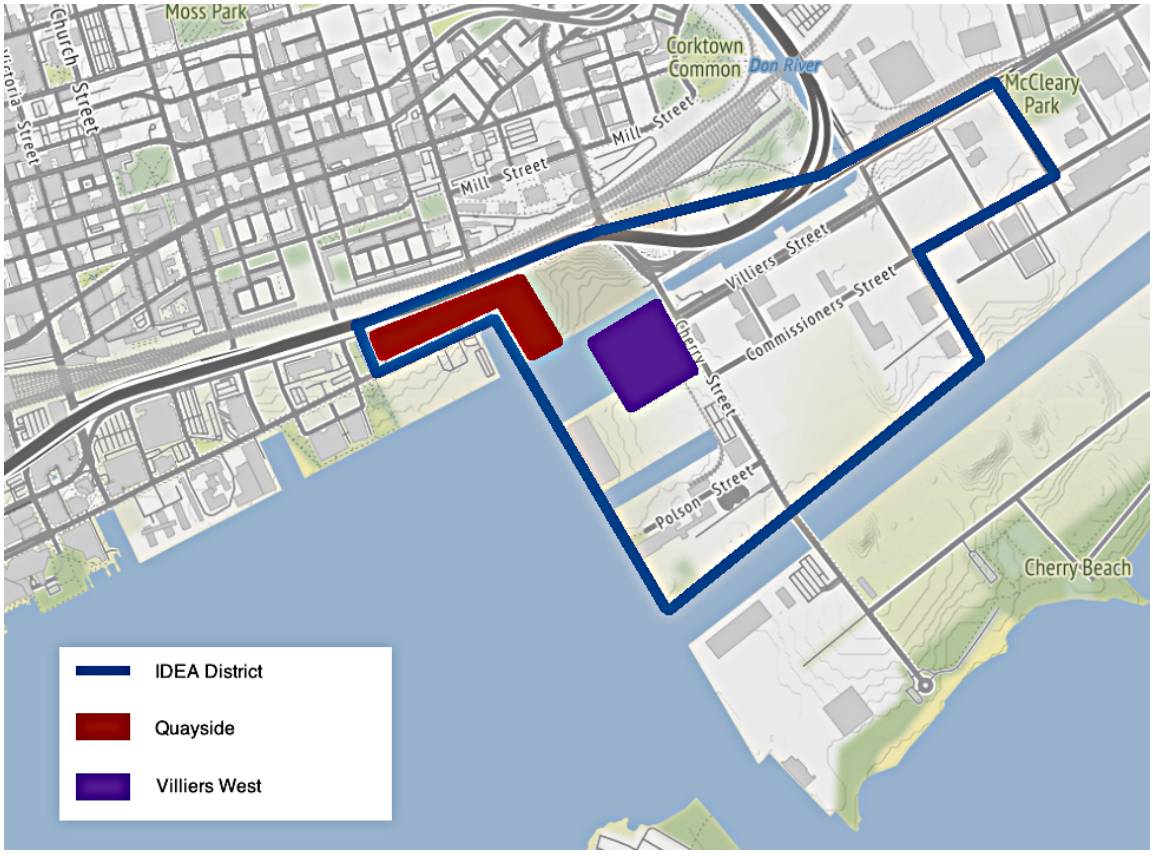

Figure 1. Proposed SL IDEA district representing current site conditions. Proposed flood protection measures are not represented. Source: OpenStreetMap (openstreetmap.org) contributors under the Open Database Licence—CC BY-SA.

Quayside site, comprising housing for 4,200 residents to be followed by the redevelopment of a portion of Villiers Island, to be called Villiers West. Villiers West would include housing for 2,700 people along with an estimated 7,400 jobs located within a 1.5 million square foot innovation campus for applied urban innovation research which would include a new Google headquarters. To facilitate this development the "list of roles SL envisions for itself [grew] to include: planning partner; real estate research and development; real estate economic development catalyst; infrastructure financing; horizontal development partner; advanced infrastructure facilitator; technology deployment; investments in economic development, and value sharing" (Robinson & Coutts, 2019, p. 339). The Ontario Auditor General's Report ultimately concluded that Waterfront Toronto's "new agreement with SL raises concerns in areas such as consumer protection, data collection, security, privacy, governance, antitrust and ownership of intellectual property" (OAG, 2018, p. 649).

When SL's draft Master Innovation and Development Plan (MIDP) was published in June 2019, it laid out a 1,500 page vision for Quayside as well as the neighbouring Villiers West district of the waterfront (Sidewalk Toronto, 2019). The MIDP includes a raft of proposals designed to pilot new technology and building methods, including the use of timber for high-rise construction, adaptable 'loft' spaces with flexible wall panels, clean thermal grid, smart underground disposal system for waste, weather-adaptable buildings, new mobility services, and modular pavement systems, to name a few—all managed through a series of sensors integrated throughout the development (Sidewalk Toronto, 2019). Spread over three volumes (The Plans, The Urban Innovations, and The Partnership) it outlines three key ideas as distilled by Waterfront Toronto which produced a 'Note to Reader' to aid the public in understanding the extensive proposal, as no executive summary was provided by SL (Waterfront Toronto, 2019a). The first relates to the proposed expansion of the project through the creation of the IDEA District spanning 77 hectares that SL argued was necessary to meet Waterfront Toronto's required priority outcomes. The proposed district would be overseen by a public administrator who reports to Government, an innovation framework that would allow for necessary regulatory and legal changes as well as design innovations, and the provision of a range of financial tools to help fund infrastructure. Secondly, four roles are proposed for SL: Lead real estate and advanced infrastructure developer for Quayside and adjacent Villiers West; Chief advisor on incremental changes to technical and regulatory innovation and design standards as the project develops; the delivery of new technological solutions; and an optional role in financing local and advanced infrastructure and a new light rail line jointly with the different levels of government. Finally, a financial structure for the development is included in relation to real estate, infrastructure, and intellectual property. The process leading up to the MIDP's creation and subsequent proposals were however met with varied levels of suspicion, to which we now turn.

4. Disrupting the (Smart) City Narrative

4.1. From Public to Private Interest on the Waterfront

Since its inception, Waterfront Toronto's lack of key financial and legal powers saw it focus on facilitation, consultation, and strategic planning through the establishment of relationships with a wide array of Toronto stakeholders (Bellas & Oliver, 2016). Despite this long history of openness, Waterfront Toronto behaved in an extraordinarily secretive manner in its early dealings with SL when Will Fleissig was the CEO. For example, Goodman and Powles (2019) note:

- Agreements between Waterfront Toronto and SL were kept private and not subject to freedom of information requests, with the original terms of the partnership kept hidden from the public eye for nine and-a-half months. Additionally, the terms of the MIDP were kept largely secret until they were announced in July 2019;
- Public engagement exercises were often managed by SL, lacking specifics and accountability to the public;
- Despite the resignations of high-profile advisors to the project and public opposition, there were no identifiable reflections or alterations to plans and processes.

The secretive nature of the planning process and the deferential disposition of Waterfront Toronto to SL is all the more difficult to fathom given the scale of resources that the public sector was committing to the project. SL had made no secret of the fact that it had no interest in the project unless public funding was made available to invest in flood protection infrastructure and in a light rail network (Deschamps, 2019; Sauter, 2018). Government had already committed CAD$1.25 billion to the former, while the latter project remains to be worked out, with SL's CEO proclaiming that "at the end of the day, if there is no light rail through the project, then the project is not interesting to us" (Deschamps, 2019, p. 1). Doctoroff made the claim following criticism of leaked documents from SL that suggested the company could help to finance the light rail project if the city was willing to provide a portion of property taxes, development fees and increased land value stemming from the development to SL (Oved, 2019).

Aside from the issue of public funds, arguably the most important concern of all has been the potential privatisation of personal data collected as part of the project. Criticism has come from multiple angles, with the MIDP being criticised by Waterfront Toronto's arms-length Digital Strategy Advisory Panel, made up

of experts from academia, industry, the civic technology community and law, who argued that the issue of data governance should not be decided by SL but rather "the development of data governance for this project—including assessment of whether a data trust is an appropriate vehicle—should, going forward, be led by Waterfront Toronto and its government partners" (Waterfront Toronto's Digital Strategy Advisory Panel, 2019, p. 24). One of the most prominent and tenacious critics of the SL proposals for data governance has been Bianca Wylie, who argues that the rules and regulations of public governance need to catch up with big tech practice because they were fashioned in the pre-internet era (Bliss, 2018). She also challenged the underlying narrative of the whole project, saying: "Let's take a minute here to stop and reframe the narrative. This is not an urban planning project, it's a technology project. As for a technology project, the biggest issue is not privacy, it's governance" (Wylie, 2018, paras. 18–19). Re-asserting the role of public governance is not easy when all three levels of government—at city, provincial and federal level—have been enthusiastic advocates of the partnership with SL. To date therefore the main public critics of the project have come from the realm of urban civil society.

4.2. Civil Society Reactions

Scholars have argued that public governance is under threat in Toronto from a combination of privatisation (of personal data and intellectual property), domination (through rights-of-way and tech interfaces), and platformization (where the city becomes beholden to SL's private platform; see Goodman & Powles, 2019). These themes are echoed within the city's civil society where reactions to SL's plans have been triggered at two levels, locally and nationally. At the local level one of the main organised reactions has been the formation of *BlockSidewalk*, which it says is a campaign to develop Toronto's waterfront for the benefit of Torontonians, not corporate shareholders. The civil group called on Waterfront Toronto to reject a business deal with SL, and reset the planning for Toronto's eastern waterfront, "this time with planning, procurement and consultation remaining firmly in public hands" (Blocksidewalk.ca, 2019, para. 1).

At the national level the Canadian Civil Liberties Association (CCLA) is suing the three levels of government that collectively control Waterfront Toronto to halt the potential privatisation of personal data. In an open letter to the Federal, Ontario, and Toronto governments, the CCLA said that Sidewalk Toronto and the Quayside project should be reset, until all three levels of government, after adequate public consultation, have established:

> Digital data governance policies for the appropriate collection, ownership, use and residency of personal information and other data obtained from public places in any embedded sensor laden, data harvesting Smart City contemplated for Quayside. (CCLA, 2019, para. 3)

In contrast, the Toronto Region Board of Trade claims that there is popular support for the SL plan because, in a poll it commissioned, 55% of residents supported the Quayside project and 76% believed that it should proceed "if the public interest can be safeguarded as the process unfolds" (Wray, 2019, para. 3).

However, these differences are ultimately resolved, it is clear that Toronto has acquired an international reputation for hosting a smart city model that is top-down and tech-driven, a model that is being compared unfavourably with other cities. In Barcelona, for example, the city government is pioneering a citizen-centric design, asserting citizens' 'digital sovereignty' by emphasizing civic participation, social impact and public return (March & Ribera-Fumaz, 2018). Its chief technology officer was keen to contrast Barcelona's approach to applying technology to solve existing everyday problems versus SL technology first mindset (Thornhill, 2019).

Scholars are also comparing the two cities with respect to the ethics of smart city design. As Rob Kitchen has argued: "Whereas Toronto appears to treat ethics in a procedural way, the Barcelona Digital City Initiative is designed to be open, inclusive, and participatory in practice and ambition" (Kitchen, 2019, para. 5). He goes on to argue that Barcelona's approach aims to push back against the marketisation of local infrastructure, services, and data while seeking to re-define smart cities as places founded on transparency, rights, and community. This leads us to now consider the role of the planner in the development of Toronto's smart city.

4.3. What Role for the Urban Planner?

As the SL project has developed there has been a distinct lack of involvement by urban planners, at least publicly. The MIDP broadly aligns to and builds on a wide range of planning strategies that have already been produced, such as the city's TOcore Building for Liveability (City of Toronto, 2018), Complete Streets Guidelines (City of Toronto, 2019), and guidelines around privately-owned publicly accessible spaces (City of Toronto, 2014) as well as Waterfront Toronto targets for affordable housing provision. The Quayside and Villiers West neighbourhoods are covered by two city approved precinct plans, the 'East Bayfront' and the 'Keating Channel.' Both plans involved extensive engagement with key stakeholders, residents, businesses, the city and associated agencies over several years (Waterfront Toronto, 2005, 2010). While it is common for precinct plans to evolve and become more concrete as individual projects develop, our preceding discussion highlights a number of concerns regarding the lack of engagement with Waterfront Toronto's Board, the City of Toronto, its associated agencies such as the public

transportation provider, nearby residents, surrounding land owners, and businesses. SL and Waterfront Toronto both view the MIDP as a draft which is intended to evolve following further consultation.

Based on an assessment by Waterfront Toronto (2019a), the MIDP generally conforms to the two existing precinct plans in relation to the provision of community facilities, connectivity, and role of the main arterial right-of-way running through the site. The MIDP diverges from the two precinct plans by proposing lower levels of density, building height, and on-site parking but higher levels of non-residential uses as well as differences in proposed building mass and built form. Overall, the 'plan' components of the MIDP align to the planning principles established in the two precinct plans but the focus of the plan heavily favours proposed 'techno-centric' innovations such as noise and air quality nuisance monitoring, active stormwater management, smart pavements, and autonomous vehicles all of which rely on a variety of sensors to capture and then process data in real-time (Sidewalk Toronto, 2019). Unsurprisingly, it is the data collection and monitoring proposals that have been the most controversial in the public eye. In response to criticism about who would have access to neighbourhood generated data, SL proposed the creation an independent Urban Data Trust to manage access. But the proposal continued to raise concerns, with critics arguing that SL should not be the ones directing the creation of the trust and the Ontario Information and Privacy Commissioner noting in an open letter to Waterfront Toronto that current proposals have "a lack of independent public oversight, a cumbersome mandate that overlaps with that of my office and the federal Privacy Commissioner, and an insufficient role for the City given its experience delivering 10 municipal services in the public interest" (OIPC, 2019, pp. 9–10).

Applying a procedural view of the public interest to SL planning process to date, there is much lacking. From March 2017 to October 2019, the techno-utopianism (Söderström et al., 2014; Wiig, 2015) narrative in Toronto has seen SL as the inevitable victor in the bidding process, a limited engagement with stakeholders, an overreaching in terms of scope of the plan, and lead architect of proposed new institutions of governance. Filling the governance void, Toronto's civil society sought to push back and argue for the public interest via a citizen-centric narrative advocating for data protection, civil rights, and enhanced governance mechanisms. Usually quite visible during the re-development of neighbourhoods the traditional roles of the planner during this period have been superseded by data scientists, public relations officers, businesses, and civic society in the SL public debate.

Substantively, SL proposed urban innovations include a number of laudable goals, but too often the emphasis is placed on the technological innovation rather than a careful examination of the outcome of the intervention. Here too planners were largely absent in the public debate about the merits of the urban innovations and the impact they might have on those who will live and engage with the proposed neighbourhood. Beyond issues of data privacy, there are wider concerns to which planners may yet lend their voices at the formative stages of plan evaluation, including the impact on disadvantaged members of the community, cost-effectiveness, political acceptability, and viability. The future suggests planners may however have a stronger role.

At the end of October 2019 Waterfront Toronto issued its response to the MIDP and subsequent agreement with SL. In a two-page open-letter Waterfront Toronto Chair Steven Diamond provided a harsh rebuke of key aspects of the proposals, stating "concerns were rooted in our public interest mandate" (Waterfront Toronto, 2019b, para. 6). This led to an agreement with SL that saw the amount of land reduced back down to the original 4.9 hectares, elimination of the Urban Data Trust proposal, decline of SL request for new governance mechanisms, reversal of SL from lead developer to partner, no requirement for a LRT-line as a precondition, expansion of patent rights for Canadian companies, and entitlement of Waterfront Toronto to a share of intellectual property based on the percentage of revenues as opposed to profits. Also agreed was the creation of a public agency to house data gathered from the project and acknowledgement that 'digital proposals' may be reviewed through public meetings and require government approvals (Waterfront Toronto, 2019c). On this last point city planners may yet play a key role in constructing and then protecting the 'public interest' as the process shifts from broad debates on governance to the details of by-laws, policy, legislation and process.

5. Conclusion

While acknowledging the contested nature of the concept of the public interest, engagement by planners in the public debate about the procedural and substantive public interest dimensions of the proposed SL plan have to date been limited. Instead, Toronto's rise as a technology hub on the global stage initially shifted the focus away from the public interest and towards the corporate ideals of smart urbanism, with less public attention being paid to the traditional planning components of the plan. The very public clash between corporate and civil society on Toronto's waterfront risked a winner-take-all battle for the future smart city. Given the capitulation of SL to Waterfront Toronto's demands it appears citizen-centric narratives of the smart city have won the first round.

The general lack of direct engagement by planners in the smart city debate however suggests a need for cities to fashion new multi-disciplinary teams in which urban planning functions are blended with digital innovation functions and data analytics expertise so that planning is reimagined for the digital era. Lessons from the preceding case study also suggests there is a need to further explore the ways in which municipal activism and civic engagement are harnessed in smart city debates to

advocate for the public interest. While future research should focus on the multi-scalar nature of planning policy to understand how local plans are aligned with and supported by national regulations on data privacy and data governance.

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Conflict of Interests

The authors declare no conflict of interests.

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About the Authors

Kevin Morgan is Professor of Governance and Development in the School of Geography and Planning at Cardiff University, where he is also the Dean of Engagement. His interests include the theory, policy and practice of place-based innovation systems; multi-level governance regimes; experimental governance; sustainable food systems; and the foundational economy. Apart from his academic work he has worked with the European Commission, the OECD, and numerous governments, development agencies and civil society organisations in Europe.

Brian Webb is a Senior Lecturer in Spatial Planning in the School of Geography and Planning at Cardiff University. He has over 10 years of experience in planning practice and research and has been involved in policy-focused research for a range of public, private, and non-profit organisations. He has undertaken research on the governance and implementation of national planning policy, strategic planning, infrastructure planning, and housing and neighbourhood dynamics.

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Article

Conceptualizing Testbed Planning: Urban Planning in the Intersection between Experimental and Public Sector Logics

Lina Berglund-Snodgrass [1,2] and Dalia Mukhtar-Landgren [2,3,*]

[1] Department of Spatial Planning, Blekinge Institute of Technology, 371 79 Karlskrona, Sweden; E-Mail: lina.berglund-snodgrass@bth.se
[2] K2–The Swedish Knowledge Centre for Public Transport, 222 36 Lund, Sweden
[3] Department of Political Science, Lund University, 221 00 Lund, Sweden; E-Mail: dalia.mukhtar-landgren@svet.lu.se

* Corresponding author

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Abstract
Urban planning is, in many countries, increasingly becoming intertwined with local climate ambitions, investments in urban attractiveness and "smart city" innovation measures. In the intersection between these trends, urban experimentation has developed as a process where actors are granted action space to test innovations in a collaborative setting. One arena for urban experimentation is urban testbeds. Testbeds are sites of urban development, in which experimentation constitutes an integral part of planning and developing the area. This article introduces the notion of testbed planning as a way to conceptualize planning processes in delimited sites where planning is combined with processes of urban experimentation. We define testbed planning as a multi-actor, collaborative planning process in a delimited area, with the ambition to generate and disseminate learning while simultaneously developing the site. The aim of this article is to explore processes of testbed planning with regard to the role of urban planners. Using an institutional logics perspective we conceptualize planners as navigating between a public sector—and an experimental logic. The public sector logic constitutes the formal structure of "traditional" urban planning, and the experimental logic a collaborative and testing governance structure. Using examples from three Nordic municipalities, this article explores planning roles in experiments with autonomous buses in testbeds. The analysis shows that planners negotiate these logics in three different ways, combining and merging them, separating and moving between them or acting within a conflictual process where the public sector logic dominates.

Keywords
experimental governance; institutional logics; urban experimentation; urban planning; testbed planning

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1. Introduction

Urban planning is, in many countries, increasingly intertwined with local climate ambitions, including expectations on municipalities to implement sustainability goals (Davidson & Gleeson, 2018). In addition, cities are investing in urban attractiveness, such as brownfield development, place marketing and "smart city" innovation measures. In the intersection between these trends, urban experimentation has developed as a means for finding solutions to urban challenges (cf. Evans & Karvonen, 2014; Haarstad, 2017; Raven et al., 2019) as well as promoting national innovation. Urban experimentation can take the forms of urban living labs, pilot projects and testbeds, which all constitute processes where actors are granted space to develop and/or test innova-

tions, often in collaborative settings (Menny, Voytenko Palgan, & McCormick, 2018; Mukhtar-Landgren, Kronsell, Voytenko Palgan, & von Wirth, 2019). Experiments are conducted in a range of areas from transport to energy efficient housing, with the common goal of sharing knowledge to facilitate policy learning, including scaling up and disseminating results with the ambition to generate system change (von Wirth, Fuenfschilling, Frantzekaki, & Coenen, 2019).

In the urban setting, experimentation can be said to constitute both an approach to sustainability and an arena, eg. an institutional and geographical bound space (Voytenko Palgan, McCormick, & Evans, 2018). One example of the latter is the urban testbed, which we here define as a geographically delimited site of urban development, in which urban experiments constitute an integral part of planning and developing the area (cf. Calvillo, Halpern, LeCavalier, & Pietch, 2015; Eneqvist & Karvonen, 2019), which often—but not exclusively—are situated in centrally located industrial areas (brownfield sites) or in areas with little or no previous development (greenfield sites). These sites are often promoted and labelled as "innovative" or "smart," and through such a status are seen as separate from their immediate surrounding (Burton, Karvonen, & Caprotti, 2019). Labelling urban development districts as "smart" constitutes a popular practice among policy makers and others involved at trying to gather entrepreneurial initiatives connected to ICT developments and mainstream these developments within the fabric of the city (Raven et al., 2019), but also among those who seeks to accelerate innovations for the transition to sustainability (Haarstad, 2017). The notion of "smart city" constitutes a powerful rhetorical and legitimating device for catalysing and lending coherence to such a variety of practices (Cowley & Caprotti, 2019), but "smart" is also promoted as an ethos for managing and governing cities of the future (Karvonen, Cugurullo, & Caprotti, 2019).

In the Nordic countries, experimentation is increasingly employed in development processes on these testbed sites. One possible reason for this is the incidence of external (including state) funding for experimentation. Another is the interest from companies to develop products, such as autonomous vehicles, in "real life settings" (Berglund-Snodgrass, Mukhtar-Landgren, & Paulsson, 2019). In essence, the development of testbed areas is carried out through parallel processes of urban planning and experimentation, which can be said to be permeated by two different institutional logics—a public sector logic and an experimental logic.

The aim of this article is to explore processes of testbed planning with regard to the role of urban planners in the intersection between urban planning and experimentation. We define testbed planning as a multi-actor, collaborative planning process in a geographically delimited area, with the ambition to generate and disseminate learning while simultaneously developing the site.

A small but growing literature is exploring the relationships and tensions between traditional urban planning and newer processes of urban development. In this context, Agger and Sørensen (2018) have analyzed tensions in planning roles in relation to processes of collaborative innovation in urban planning. Other studies include the relationship between urban planning and smart city development (Cowley & Caprotti, 2019) and urban governance experiments (Davidson & Gleeson, 2018). The role of public actors has also been analyzed beyond urban planning, including the role of municipalities in urban experimentation in a broader sense (e.g., Castán Broto & Bulkeley, 2014; Kronsell & Mukhtar-Landgren, 2018). One aspect that has been highlighted in this context is the emergence of new roles for municipal civil servants (Makkonen, Merisalo, & Inkinen, 2018), including new intermediating roles (Hakkarainen & Hyysalo, 2016). Yet, research has also shown that the traditional roles that permeate public administration persist alongside these new roles (cf. Karvonen, Evans, & van Heur, 2014). The extent to which urban experimentation more specifically contributes to influencing and shaping the traditional planning role is less explored, and it is here that this article sets out to make its contribution. The next section delineates the institutional logics perspective and the two logics that are set center stage for analysis, thereafter we describe the material and the methods applied.

2. Testbed Planning Set within Public Sector and Experimental Logics

The notion of institutional logics has been developed in neo-institutional theory where institutions are understood as including not only formal, but also informal aspects such as roles, identities and norms (March & Olsen, 2013). Institutional logics is a way to analyze the different beliefs and practices that shape how individuals act (Thornton & Ocasio, 2008, p. 101). They are seen as "organizing principles" which provide "social actors with vocabularies of motive and a sense of self (i.e., identity)" (Thornton & Ocasio, 2008, p. 101). The core of the concept is the link between individual action and understandings of "appropriate and legitimate behavior" (Fred, 2018, p. 35; cf. Thornton & Ocasio, 2008). Here, we use logics as ideal types, and analyze how planners relate to and negotiate between them in testbed planning processes. Below, we outline a framework for analyzing processes of testbed planning, based on two logics—a public sector logic intrinsic to "traditional urban planning" and an experimental logic intrinsic to "urban experimentation." We have set out five differences and points of negotiations between them. These are *problem representations*, *means for goal attainment*, *governing tools*, *relation to stakeholders* and *priorities*. The logics, and these points of negotiation, are based in previous discussions and categorisations on public sector and institutional logics in flux (e.g., Agger & Sørensen, 2018;

Bryson, Crosby, & Bloomberg, 2014), as well as in literature on experimental governance. The two logics will be described below.

2.1. The Public Sector Logic

The public sector logic is here understood as the formal governance structure of "traditional" urban planning, where the legitimacy of municipalities, as part of government, rests on its democratic and bureaucratic function. Democratic legitimacy more specifically relates both to the representative function of municipalities with an emphasis on input-legitimacy (such as democratic accountability), but also concerns output legitimacy (relating to implementation capacity and results; Kronsell & Mukhtar-Landgren, 2018). Planners, in their formal capacity, thus act as parts of a bureaucratic and political organisation configured to ensure the delivery of political objectives while taking account of public values. For urban planners, public values are comprised by both professional norms residing within all public professions (such as medical professions, the police force, teachers and urban planners), but also more general bureaucratic norms common for all professions including procedural values such as accountability, legality, impartiality and rule of law (cf. Hysing & Olsson, 2012; Lundquist, 1988; Svara, 2006). Acting within the frame of public administration, of which urban planning is a part, "is thus primarily about meeting the demands of official, not individual, personal responsibility and accountability" (du Gay, 2017, p. 158). The fact that urban planning represents a decision making body and in that way has to sustain democratic legitimacy, makes it inherently different from other participating actors in these test-bed planning collaborations.

The first category used to analyze negotiations between the two logics is *problem representations,* i.e., the question of which type of problems are in focus. Traditional urban planning is generally understood as being organized to respond to a set of societal conditions prominent in the 20th century, including industrialization, rapid urbanization and a strong belief in progress (Bryson et al., 2014). In a post-industrial context, these ideals are further connected to urban entrepreneurialism and an understanding of urban growth as related to an inter-urban competition between cities on a global market (Hall & Hubbard, 1998; Harvey, 1989). The second category concerns how public actors reach policy goals, or their *means for goal attainment*. Planning goals are determined by political electives and the means are determined, organized and delivered through a hierarchical bureaucratic system (Agger & Sørensen, 2018). This relates to the third category, *governing tools*, which here includes bureaucratic routines such as formal legislation and regulations (Allbrecht, 2004). The fourth category is *the relation to stakeholders*. In a public sector logic, authority is distributed hierarchically (Agger & Sørensen, 2018), and planners balance private and public interests through bargaining and negotiating with stakeholders and placing demands on private actors through legislation (cf. Nadin, 2007). When operating according to this logic, the *priorities* (the fifth category) are to maintain order, control and stability (Agger & Sørensen, 2018). One important aspect is the importance of long-term planning solutions based on knowledge, i.e., what we comprehensively know and can predict and foresee in the future (cf. Rydin, 2007).

2.2. The Experimental Logic

The experimental logic is instead characterized by the collaborative, testing, learning and innovative structure of urban experimentation. In essence, this logic is permeated by an implicit critique directed towards traditional urban planning, suggesting that there is a need to go beyond "business as usual" and find new solutions. This can include assumptions of traditional urban planning as being path-dependent and plagued by organizational inertia—and consequently in need of renewal (cf. Carroli, 2018). This can also be related to an overall discourse on "wicked problems" i.e., the widespread notion that today's societal problems are so difficult that they require new forms of governance to be solved (cf. Bryson et al., 2014, p. 447). This is also one of the *problem representations* within urban experimentation, which is configured to respond to another set of societal conditions such as neoliberalism and austerity (Bryson et al., 2014). In accordance, the *means for goal attainment* include opening up processes for a plethora of actors in the attainment of public goals, where planners facilitate service delivery through *governing tools* related to various forms of enabling, such as facilitating (Mukhtar-Landgren et al., 2019). Facilitating is referred to here as "providing opportunities to other people, by educating, gathering and distributing resources, influencing regulations, developing the local rules, and creating "spaces" for others to act" (Hakkarainen & Hyysalo, 2016, p. 47). Central to this logic is that authority is seen as distributed horizontally (Agger & Sørensen, 2018) which impacts the planners' *relation to stakeholders*. They engage in "co-producing" activities with private actors and other stakeholders rather than regulating them (cf. Voytenko Palgan et al., 2018). *Priorities* are testing, creativity and (radical) change rather than maintaining order and upholding stability (Agger & Sørensen, 2018). Finally, we recognize that several characteristics of experimentation, such as co-producing of knowledge and the incidence of horizontal networks and dialogues, have been intrinsic to other planning ideals over time, including both advocacy planning (Davidoff, 1965) and communicative planning ideals (cf. Forester, 1989). In addition, it is important to also point out that several of the more current trends described above are not exclusive for urban experimentation: Urban planning has, at large, experienced significant changes during the last decades (Olesen & Richardson, 2012; cf. Healey, 1997). This includes the introduction of more strategic means of inte-

grating and coordinating spatial policies across sectors, including the increasing incidence of stakeholder collaborations (Allmendinger & Haughton, 2009; Allmendinger, Haughton, & Shepard, 2016; Nadin, 2007), entailing that the collaborative settings intrinsic to urban experimentation are not exclusive for experimentation. In addition, it has been pointed out that urban planning carried out within such informal planning arenas are, to an increasing extent, shaping formal planning processes (cf. Olesen, 2014). Instead, and to sum up, the ideal typical characteristics outlined above are analytical constructs; they are not exhaustive or mutually exclusive. They function to elevate fundamental aspects of the different logics for illuminating how urban planning balance these in testbed planning processes. The logics are summarized in Table 1.

3. Method and Empirical Material

This article draws from an in-depth multiple-case study (cf. Yin, 2014) which allows for the investigation of testbed planning processes across multiple settings, and through this, gain a deeper understanding of how such processes are enacted in the intersection between the different logics. We are specifically interested in identifying common insights of test bed planning across cases rather than comparing and identifying differences. The cases are selected from Nordic countries that all share a similar tradition of a decentralized state and strong local autonomy (Loughlin, 2000). The Nordic planning systems can be described as being characterized by a comprehensive planning model and urban planning constitutes primarily a municipal affair (Fredricsson & Smas, 2015). Since we are interested in testbed planning, we have strategically chosen three cases of such processes in three Nordic municipalities. To be seen as examples of testbed planning, the cases should comprise an ongoing urban experiment in a geographically delimited testbed site. As outlined in the introduction, we define a testbed as a delimited geographical site of urban development, in which experiments constitute an integral part of planning and developing the area. The testbed planning processes in the three cases consists of experiments with smart mobility solutions (autonomous buses in so called "real world settings") in delimited testbed sites. The testbed sites are labelled by the municipalities as "smart city districts" or "innovation sites" for sustainable development. As we are particularly interested in the role of urban planners in these testbed planning processes, we have conducted interviews with two main types of actors: (1) municipal actors such as urban and transport planners, development managers, coordinators and engineers, and (2) intermediary actors such as project managers. We define an intermediary actor as "[a]n organization or body [or an individual] that acts as an agent or broker in any aspect of the innovation process between two or more parties" (Howell, 2006, as cited in Hakkarainen & Hyysalo, 2016, p. 46). The intermediaries are seen as "operating between different social interests (and technologies) to produce outcomes that would not have been possible without their involvement" (Marvin, Bulkley, Mai, McCormick, & Voytenko Palgan, 2018). In all three cases, the intermediary actors are situated in partnership organisations—between the municipality(ies) and private actors. The partnership organisation operates within the overall objective to jointly develop smart and sustainable urban solutions.

The empirical material as a whole consists of policy documents as well as fifteen semi-structured interviews with these two main types of actors. The interviews were carried out between September 2018 and February 2019 and concerned the different actors' perceived roles, tasks and duties and their overall contributions in the testbed planning processes. The interviewees were also asked to reflect on the connection between the urban experiments and the everyday planning processes.

We use ideal types as an analytical method for analyzing how planners navigate their different roles in testbed planning. Using ideal types is theoretically driven and the categories on the "x" and "y"-axis emanate from the established literature (cf. Reay & Jones, 2016). The analysis was carried out in two steps. First, we identified the five categories as stipulated in Table 1 in the empirical material. We specifically focused on how these five aspects

Table 1. Five points of negotiations in testbed planning.

	Public sector logic	**Experimental logic**
Problem representations	Industrialism, (post-industrialism), urbanization, progress, modernism, inter-urban competition	"Wicked problems," "hollowing the state," neoliberalism
Means for goal attainment	Hierarchical organizations, formal decision making procedures	Enabling service delivery from different providers
Relation to stakeholders	Balancing between private and public interests	Co-creating solutions with private and public stakeholders
Governing tools	Regulating including legislation	Enabling (facilitation, visioning, collaboration)
Priority (from Agger & Sørensen, 2018)	Order, predictability, control and stability	Creativity, testing and experimentation

were managed in the development processes with specific regard to urban planners, and the material was organized using them as our point of departure. Second, we analyzed the material in relation to how urban planners negotiated between them. Below, we briefly summarize the results of the analysis, and thereafter we give three examples of negotiations from our material.

4. Summary of Results

The results of the analysis (summarized in Table 2) illustrate the incidence of both logics. In relation to problem formulations, the experimental logic was visible in the emphasis on the need to go beyond "business as usual," and the public sector logic shone through in the emphasis on post-industrial problematizations relating to branding and inter-urban competition. It appears as there is no tension between the logics, instead public actors combine and reconcile them in their reasoning around urban experimentation in testbed planning. This form of negotiation was also evident in relation to stakeholders: Even though there is a tradition in urban planning to negotiate with private actors and developers, the "new" role of co-creating solutions was not approached as conflictual but possible to combine with traditional planning practices. In relation to the means for goal attainment, there was neither a tension—nor was there any apparent will to combine the different logics' means of service delivery. Even though urban experiments were generally described as something completely different from traditional planning processes, urban planners managed to separate yet move between them without reconciling them, somehow wanting to separate "real" planning from new processes of urban development, without seeing them as conflictual. This way of navigating also characterized their relation to governing tools. Urban planners moved between the referring to formal planning tools (regulations, etc.) and their role in providing opportunities for external actors. Finally, when it comes to priorities in urban planning, the logics are emphasized as rivalry. Testing and risk taking, central dimensions of urban experimentation, open up a conceptual space of failing, which don't resonate well with notions of order, predictability and stability that characterize traditional urban planning. Summing up, there is a variation in how well urban experimentation "fits" the public logic of urban planning; there is sometimes a perceived need to separate what planners "do" in relation to new innovative trends, but in other cases, differences in problematizations and approaches are reconciled. Sometimes this movement appears without friction, and sometimes it appears more conflictual. To conclude, we identify three different ways in which urban planners navigate between the two logics: They (1) combine and reconcile them, they (2) separate yet move between them, and finally (3) they emphasize rivalry positions. In the following section we will analyze these negotiations further by providing examples from the empirical material.

5. Analysis: Negotiating between Logics in Testbed Planning

In this section, we analyze negotiations between the public sector—and experimental logics in processes of testbed planning with specific regard to urban planners. The first example is how urban planners combine and reconcile the logics, which we illustrate in relation to their handling of *problem representations*.

5.1. Combining and Reconciling: Responding to "Wicked" Sustainability Problems whilst Contributing to Progress

Our analysis showed that the *problem representations* inherent to the different logics, the traditional problem

Table 2. Public sector and experimental logics in three examples of testbed planning.

	Public sector logic	Experimental logic	How city planners navigate between the logics
Problem representations	Emphasis on post-industrialism, urbanization, progress as related to innovation. Focus on branding relating to inter-urban competition.	Strong emphasis on "wicked problems"	Urban planners combine and merge the two logics
Means for goal attainment	Hierarchical organizations	Enabling service delivery from different providers	Urban planners move unproblematically between the two logics
Relation to stakeholders	Balancing between private and public interests	Co-creating solutions with private and public stakeholders	Urban planners combine and merge the two logics
Governing tools	Regulating incl. legislation	Enabling (facilitation, visioning, collaboration)	Urban planners move unproblematically between the two logics
Priority	Order, control and stability	Creativity, experimentation and change	Conflicting logics. public sector logic dominates

representations related to progress and modernism in the post-industrial city, and problem representations related to "wicked problems," are combined and reconciled in testbed planning processes. In practice this entails a new and powerful discourse of smart and sustainable urban development which contributes to urban progress, both in an economic and scientific sense. The importance of branding urban development districts is repeatedly mentioned by the municipal actors as a key dimension for why they choose to participate in processes of urban experimentation. Experimentation with smart technology is brought forward as having the capacity to attract investments to the testbed-site, and through this contribute to deliver the overarching municipal visions for the development of the districts. One project manager formulates the branding exercise through experimentation like this:

> The shuttles, as we see it, are really important because they can deliver many things, they can not only deliver this first last mile to and from the light rail way, they also have the ability to somehow brand the area as something new, and they potentially can facilitate the transport itself in the area….So the municipality is working with a master plan for the area, it's close to [a major city], so it's attractively placed, it's close to the light rail, it has education institutions, and it is close to beautiful green areas, so there are a lot of elements that make this an attractive area. How can the municipality use these elements and the driverless shuttle as a first last mile solution, how in that combination can they help the municipality attract investors to realize the vision for this area? (Project manager 1)

The quotation illustrates how different ideas are merged and reconciled, and problems solved through testbed planning processes. Testbed planning is construed as responding to a "wicked" sustainable-mobility problem (experimenting with solutions for the "first mile/last mile problem") whilst simultaneously responding to expectations of economic progress by regenerating and "branding" the city, attracting investors and increasing municipal revenue. Partaking in urban experiments and enabling the advancement of technology constitute prerequisites (or a necessary evil) for being able to brand and promote the urban development districts. Enabling technological progress is sometimes framed by the planners as a societal good in its own right, arguing that "if we are not putting our roads at their service, we might not go anywhere with autonomous mobility" (Interview, Transport planner 1). Summing up, urban planners in testbed planning manage to reconcile the problem representations inherent to the different logics on a discursive and rhetorical level, through the powerful legitimating principle of smart and sustainable urban development. Through such a discursive and rhetorical reconciliation of ideas, the urban planners provide a way for the logics to be merged rather than appear as competing.

5.2. Moving between Separated Positions: Regulating and Enabling

Another way of negotiating between the logics was the tendency to separate and move between them. To illustrate this point, we use the category governing tools. In testbed planning, urban planners regulate experiments in the statutory aspects of planning (e.g., granting building and/or road permissions) as well as enable experimental and collaborative activities in various ways such as participating in workshops and meetings. The different logics act to separately guide the planners in their different tasks as the activities are conceptualized as two separate entities that are not mutually exclusive. Planners thus manage to unproblematically move between the logics, where "new" governing tools related to urban experimentation seem unproblematic to combine with (rather than replace) more traditional planning instruments. As mentioned in the literature overview on urban experimentation, public officials are repeatedly understood as key enablers in experimental processes, as one respondent states: "they [urban planners] are what we have, they are what we offer" (Interview, Intermediating actor 1). One important actor in this context is the intermediary, which we defined above as an "[a]n organization or body [or an individual] that acts an agent or broker in any aspect of the innovation process between two or more parties" (Howell, 2006, in Hakkarainen & Hyysalo, 2016, p. 46). The intermediary actor wants to offer an easy process with the municipality to the private actors by, for example, asking the municipal actors to smoothly grant necessary permissions for the experiment to take place. One intermediary actor formulates it almost as their duty: "[we offer] a smooth process with the municipality" (Interview, intermediary actor 2). Having the civil servants on board in experiments is recognized as key by the intermediaries as they need to be legally and regulatorly endorsed. Urban planners are being encouraged to partake and facilitate urban experimentation by the intermediary organizations as well as by high level leadership within the municipal organizations, often with initiative from the politicians. One project manager formulates it like this:

> They are kind of the, enabler, I would say, it's very crucial to have their blessing on everything we do, because otherwise, if it's not there, then it won't happen….But then, I think, many of the departments in the city, they are maybe not looking forward [to participating] that much, so I think it's really important that you kind of get people excited about these new things, get them committed to these new things. (Project manager 3)

As mentioned above, it is not only the intermediary actors who are pushing for the introduction of these governing tools within the public administration. High level leadership within the municipality is also brought for-

ward (as per project manager 2). One high level leadership strategy for introducing new sets of governing tools within the public administration took the form of launching a competition between civil servants:

> We work very closely with the project manager to see where the bus could go in 2020….Last year, last spring, we had this competition…our manager told us now we want to test more of these buses. And every person working here, like ok, make your own plan where the bus might go. I think the winner got like 1000 euros or so? (Transport planner 2)

Launching a competition constitutes a significant quest for opening up new governing tools within the local government. We interpret that the competition and its associated tasks are not introduced as activities that are contradictory to, or can be merged with the urban planners' other tasks, but as something new and complementary, and thus conceived as separated and can be "added on."

Yet there is a clear separation between tools, and some are skeptical about endorsing and facilitating urban experiments in the hunt for municipal competitiveness. Here, they raise the point that municipalities must become better at prioritizing between experiments in relation to local goals (as per the municipal smart city coordinator and transport planner 2). One respondent formulates it like this:

> I see that in a lot of places, we just do it because companies come along and [say] "hey, do you want to test it" and "yeah, let's do that," and I don't think that is good for us in the long run, I, rather that we say [that we do] projects based on needs, either the citizens' needs or the people working here, that they have a need to do things better. (Municipal smart city coordinator)

In the quotation above we can identify tendencies of resistance towards this "push" for facilitating urban experiments. We interpret from our interviews that many civil servants believe that municipalities at large need to become better at conditioning their participation in urban experiments, and better at prioritizing between and regulating experiments, and thereby place demands on actors in such processes.

Summing up, urban planners engaged in testbed planning processes use governing tools from both of the logics, and opt to both regulate and enable experimental activities, and manage to move between the logics by conceptualizing them as separate activities that are not mutually exclusive. Regulating remains a core public sector governing tool but various enabling activities are simply added to the repertoire of tools among urban planners, albeit with varying degrees of skepticism amongst public actors.

5.3. Emphasizing Rivalry Positions: Not Compromising on Taking Risks

One example where the logics are emphasized as rivalry is the negotiation of priorities. The conflicting positions are brought forward in antagonistic terms which can't be compromised. Planners appear not to compromise on matters such as stability and long-term goals for the development district. These conflicting priorities are discussed by one respondent:

> On the one hand, there is an approach of being open and saying, ok, we are very interested in learning how to apply autonomous vehicles into our masterplan, city planning, and on the other hand, there is an approach saying, we don't see that this is possible, how can we do with traffic and we don't even know what kind of criteria to set up when we are going to develop, and this is too narrow lane, and there are too many trees, and what about this parking area here, so until we start the concretization of the tools and saying, now we have the test and we can see that this is possible, and this is not possible, and this is not a good idea, I think there is a tendency that the practical barriers are somehow very realistic barriers. (Project manager 1)

The quotation highlights that urban planners are conflicted between their role in participating in processes of urban experiments with a lot of uncertainties and their role in contributing to the provision of long-term planning solutions based on what they comprehensively know and can predict and foresee in the future (cf. Rydin, 2007), including the upholding of responsible public spending. Prioritizing urban experimentation is conceived as including too many unknowns for urban planners to justify. These conflicting priorities thereby affect their commitment to the urban experiment, where there is a tendency that urban planners choose to return to "traditional" comprehensive strategies when developing the testbed site. Others reinforce their own expert knowledge of how to develop the area:

> You have to understand that, when we decide to make a street somewhere and build houses around it, it is kind of a decision for 200 years, and where we have the smart city solutions, they come and go. The city structure has to be so that you actually can bring this electric car charging thing there and you can take it off also…think Champs Elysée, how the parades have gone through there, there has been Napoleon, there has been Hitler, there has been Sarkozy. I don't find any difficulty, any controversial thing, that [the smart district] starts at some point and it will end at some point also, maybe not in a hundred years, but at some point. (Urban planner 2)

What is suggested in the quotation above is that urban planning is an activity with long term objectives which exceeds the scope and priorities of urban experiments. The uncertainties that are coupled with the short term objectives of the experiments are thus not reconciled nor merged into the long-term goals of urban planning, instead a return to "business as usual" dominate: "we need to plan the area as we thought we would, and then hopefully the technology will adjust" (Interview, Municipal smart city coordinator). The urban experiments thus bring about a new emphasis in urban planning processes by its focus on understanding and responding to short-term problems in the city, which challenge the very idea of comprehensive urban planning and securing long-term goals (cf. Cowley & Caprotti, 2019). However, the urban planners in our empirical material were not ready to include this new short-term emphasis in their professional identity.

Summing up, negotiating priorities in testbed planning constitutes one example of a point of contestation between the logics, where the different priorities can't be neatly reconciled nor used to complement each other.

6. Conclusion: Testbed Planning

This article introduces the notion of testbed planning as a way to conceptualize planning processes in delimited sites where planning is combined with processes of urban experimentation. The question of how and to what extent urban experimentation contributes to influence and shape the traditional urban planning role is placed center stage in our analysis. Our point of departure is a neo-institutional perspective where actors, in our case urban planners, are embedded in institutional logics that provide provide them with a vocabulary, self-identity and motifs (Thornton & Ocasio, 2008). The analysis reveals that urban planners are based in a public sector logic, they see themselves as representatives of a profession (planners), inscribed in a trajectory of previous planning processes, and upholding the public good. They also see themselves as representatives of the formal bureaucratic planning administrations and offices by which they were employed. This entails that they also operate within beliefs and routines that shape the ways in which they engage in planning processes, which in turn guide what they deem appropriate behavior.

The analysis also shows that urban planners are open to including new aspects to their role as planners. But interestingly enough, it is primarily on a discursive or ideational level that they are able to include, combine and reconcile ideas of urban experimentation: here ideas of smart city development and innovation seem to fit into the current practices of attractive and sustainable cities. In relation to urban progress, there is an image that experimentation can be reconciled with modernity, rationality and (sustainable) development in ways that resonate with the vocabulary and self-identity of urban planners. Even though they refer to the "smart city" more as a trend (rather than an all-encompassing vision), they manage to reconcile it with a powerful notion of future cities which helps "make sense" of the processes of testbed planning.

When it comes to more concrete practices as the means for goal attainment and governing tools, there is a clear separation between traditional urban planning processes within the formal bureaucratic organization, and the newer soft governing tools of enabling. These new tools are something that urban planners can simply add on to their responsibilities, yet there is a clear need to separate the two tasks from each other, always falling back to the reality of everyday planning where issues such as regulations or safety requirements constitute the core of "real" planning processes. Smart city development as a way of working is seen more as a temporary trend, existing maybe primarily as an overarching idea, not as a process that challenges traditional planning tools in any fundamental sense (even though that is in fact often the goal with urban experimentation!). This tendency brought about frustrations among intermediary actors in municipalities, as their aim was to encourage planners to open up their processes to innovation.

Finally, there is one part of the public ethos and identity of urban planners that is not negotiable, and that is the emphasis on maintaining order, control and stability in urban development. Here a pivotal aspect is the importance of long-term planning solutions based on knowledge. In this context, the urban experiment is perceived of as a short term solution that may be carried out during a limited period of time, but is not based in the tradition of urban planning experience and knowledge on urban development narrated through education, a shared sense of how knowledge is acquired, competencies in the planning communities, and past experiences. The notion on long-term planning is thus a public sector logic that is difficult to reconcile with the notion of testing and risk-taking that characterizes urban experimentation.

Summing up, urban planners in testbed planning processes are influenced by urban experimentation, but primarily on a discursive level, and with a maintained skepticism to altering priorities and ways of working in any fundamental way. Instead of seeing new roles amongst urban planners, we noted that the characteristics associated with an experimental logic instead seemed to have materialized amongst the emerging intermediary actors. These are actors that have entered the context of local governments through processes of urban experimentation. Intermediary actors, who not so seldom have a background in entrepreneurial undertakings, have a tendency to identify themselves as private actors, or as consultants or project leaders (rather than public servants). Looking forward, a question—that requires and merits further research—is if these actors are to same extent embedded in public sector values, as they are not members of a clear profession (such as the planning profession), nor can they be expected to adhere to the more

general bureaucratic norms mentioned above, as they do not perceive themselves primarily as bureaucrats. In line with previous calls for critical engagement with the underlying politics, narratives and ideals permeating urban experimentation (Caprotti & Cowley, 2017; Kronsell & Mukhtar-Landgren, 2018), including pitfalls in relation to democratic legitimacy (Davidson & Gleeson, 2018), this analysis opens up to questions related to the actors and roles included and recreated through processes of urban experimentation. As noted by Cowley and Caprotti (2019, p. 429), experimental governance may have "unsettling effects on urban planning" which in turn "invites ongoing critical attention in future." In line with this line of reasoning, the introduction of new types of actors (moving in-between public and private sector logics) in local governments through testbed planning may thus have a profound impact on the long term democratic legitimacy of urban planning and could contribute to a possibly marginalized role for urban planners (reduced to mere implementers of planning and building regulations). The entry of new intermediary actors in urban planning process thus constitutes an important aspect for further research, not least in relation to (changes of democratic) values and norms within the local government.

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Conflict of Interests

The authors declare no conflict of interests.

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About the Authors

Lina Berglund-Snodgrass is a Researcher and Senior Lecturer in Spatial Planning at Blekinge Institute of Technology. Her research concerns ideas, roles and knowledge in planning. She is currently involved in research projects that address questions of changing roles for urban planning in urban testbeds and experiments as well as political dimensions of organising strategic and collaborative planning.

Dalia Mukhtar-Landgren is a Researcher and Senior Lecturer at the Department of political science at Lund University in Sweden. Her research includes new forms of urban planning and development, including issues such as projectification, experimentation and innovation work. She is currently engaged in research projects on testbed planning, urban experimentation, smart mobility and processes of local innovation and development practices.

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Article

EU Smart City Lighthouse Projects between Top-Down Strategies and Local Legitimation: The Case of Hamburg

Katharina Lange * and Jörg Knieling

Institute of Urban Planning and Regional Development, HafenCity University Hamburg, 20457 Hamburg, Germany; E-Mails: lange.katharina2@gmail.com (K.L.), joerg.knieling@hcu-hamburg.de (J.K.)

* Corresponding author

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Abstract
The concept of the smart city has become increasingly popular in recent years and a large number of cities globally follow smart city strategies. By awarding subsidies in the Horizon 2020 programme, the European Union (EU) has taken on an influential role in how smart city projects are conceived and implemented in European municipalities. Using the example of the smart city pilot project mySMARTLife in Hamburg, the purpose of this article is to examine the area of tension between strategically pursuing own objectives and adjustment to external provisions of the EU funding framework. In a qualitative single case study, the article analyses what implications the project mySMARTLife has on urban development practice and local governance arrangements in Hamburg. Examining current literature on smart cities from the perspective of multi-level governance and presenting the current state of research dealing with EU smart city projects, a theoretical framework is developed. The analysis reveals that, due to the EU funding framework, precise project contents are contractually defined at an early stage when local stakeholders have limited involvement in this process. Furthermore, the analysis shows that the EU smart city funding in the project mySMARTLife is more limited to the implementation of individual interventions than to a comprehensive smart city strategy. As a result, this article considers EU-funded smart city initiatives as experimental fields that enable cities to gain experiences that can be incorporated into local strategic development objectives.

Keywords
EU funding; governance; Hamburg; smart city; strategic urban planning; urban transition

Issue
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1. Introduction

In the last decade, the concept of the smart city has become extremely popular. More and more cities around the world have adopted smart city strategies or claim themselves to be smart. With the intention of simplifying local processes, enhancing sustainable development, or improving the quality of life for citizens, cities are implementing smart technologies and digital infrastructures (Alawadhi et al., 2012; Angelidou, 2014; Townsend, 2013). The concept of the smart city has long since ceased to be viewed only from a technological perspective. Holistic approaches on the topic comply with a more interdisciplinary dialogue and an increasing number of scientists from the field of urban research are examining the non-technical dimension of smart cities (e.g., Beretta, 2018; Desdemoustier, Grutzen, Cools, & Teller, 2019; Engelbert, van Zoonen, & Hirzalla, 2019). However, the idea of the smart city is still a fuzzy concept and cannot be defined in a consistent and common way as it is re-

lated to different visions, objectives and individual strategies, and is highly dependent on the respective context (Dameri, Benevola, Veglianti, & Li, 2019; Hollands, 2008; Vanolo, 2013).

In Europe, the vision of the smart city has been decisively influenced by the awarding of European Union (EU) subsidies for smart city initiatives. Seeking to reduce urban CO_2 emissions and to improve the quality of life as well as the economic performance of European cities, the EU has been tendering calls for funding smart city projects within the framework of the Horizon 2020 programme for research and innovation (European Commission, 2016). Cities that were chosen to receive EU funding for a smart city project are designated with the prestigious title of a 'smart Lighthouse city.'

With the offer of the coveted subsidies, the EU is setting standards and definitions for smart cities. On the one hand, cities that have been awarded grants as Lighthouse cities in EU smart city projects get the chance to act strategically to benefit from the grant funds and to pursue its own interests and goals of development (Haarstad & Wathne, 2018). On the other hand, grant recipient Lighthouse cities have to fulfil precise standards and targets regarding smart city development, adapt to the regulatory requirements of the EU and fulfil the agreed project framework. Thus, they bear the risk of following top-down development approaches with a lack of democratic legitimation and loss of municipal autonomy (Späth & Knieling, 2018).

The City of Hamburg has adopted the aim to become a smart city and received the designation of smart Lighthouse city within the framework of the project mySMARTLife. In 2016, a local consortium began to transform the district of Hamburg-Bergedorf to a smart city following an applied and implementation-oriented approach. Using the example of the smart Lighthouse city of Hamburg, the purpose of this article is to examine the area of tension between the strategic pursuit of the city's own objectives on the one side and adjustments to and implementation of external provisions on the other side. The research objective is to discover how the city operates within this framework and which implications the project mySMARTLife has on urban planning practice and local governance arrangements in Hamburg.

Until now, little research has delved into practical smart city experiences and their implications on the local level (Mora, Bolici, & Deakin, 2017), and the scientific community is encouraged to analyse "actually existing smart cities" (Shelton, Zook, & Wiig, 2015) regarding their implications and expectations on the local level. In order to meet the research objective, the article examines the current literature on smart cities from the perspective of multi-level governance and the concept's implementation at the local level is presented. Further, the EU-funding framework in the Smart Cities and Communities Programme is outlined and the current state of research in this area is compiled. Based on the theoretical foundations, this article develops an analytical framework and applies it to the case of the City of Hamburg and the project mySMARTLife. Knowledge and empirical findings for this purpose were collected in different ways: On the one hand, being part of the mySMARTLife consortium responsible for scientific accompanying research, the authors followed the project with an observing role during the first three years and participated in relevant work and project meetings. In this way, knowledge from the project's inside perspective could be gathered. On the other hand, in-depth interviews with five relevant project partners and the project management were conducted and evaluated. Moreover, relevant documents, such as the grant agreement and interim reports as well as the mySMARTLife website and brochures have been analysed to get a deeper understanding of the project and its logic.

2. Smart Cities from a Multi-Level Governance Perspective

In order to understand the formulation of smart city policies and the implications of their implementation at the local level, the concept of the smart city must be examined from a broad perspective. The complex policies that lie behind a smart city encompass conditions that go beyond the local level. At the same time, smart city policies require cooperation among new constellations of actors and institutions on the local level (Dameri et al., 2019). In this regard, the multi-level governance perspective describes interdependencies and dispersed authority between different vertical levels of administration as well as horizontal relationships across different ranges of action (Bache & Flinders, 2005).

Cities play a crucial role in the implementation of multinational agendas, such as climate action, sustainable development and the efficient use of resources (Bulkeley & Betsill, 2005; Ehnert et al., 2018; Rohracher & Späth, 2014). Such objectives are increasingly being pursued with the smart city approach. Accordingly, supranational organisations, such as the EU, have recognised the local scale as an important level of action and have compiled a common definition and strategic objectives regarding smart city development (Dameri et al., 2019; European Commission, 2017). Although the EU has no direct competence to act on urban policies, it tries to influence urban development indirectly through soft instruments, such as awarding subsidies for urban projects and supporting networks and knowledge transfer (Haarstad, 2016). This is also the case in the smart city field, where funding programmes are tendered, and networking and exchange platforms are promoted. In this way, policy intentions formulated on the higher level can induce and stimulate horizontal dynamics at lower levels, which can be seen as a form of multi-level reinforcement (Jänicke, 2015).

Private sector interests that go beyond the local level can also influence smart city policies in municipalities. Smart city projects are often the result of strategic co-

operation between multinational companies and local authorities. While companies see cities as sales markets for their products (Viitanen & Kingston, 2014), the aim of local actors is to implement technologies tailored to local needs and, thus, benefit from them (Caragliu & del Bo, 2019).

As outlined, certain framework conditions of smart city policies are formulated on higher, exurban levels, influencing municipal decisions. However, the local level plays a decisive role in the final implementation of a smart city concept on-site (Dameri et al., 2019). Municipalities can benefit from the blurriness of the smart city definition and interpret the concept autonomously according to their own requirements and aspirations (Haarstad & Wathne, 2018). The horizontal governance level of smart cities is characterised by the involvement of relevant stakeholders and institutions as well as new forms of collaboration between the involved entities. Also, the management of local human capital and knowledge production, as well as the participation of citizens, play a decisive role in styles of smart city governance (Caragliu, del Bo, & Nijkamp, 2011; Meijer & Rodríguez Bolívar, 2015; Nam & Pardo, 2011). The interaction of these components at the local level can be regarded as particularly decisive for the character and success of a smart city initiative.

Municipalities with smart city objectives, therefore, make use of a global concept and are to some extent dependent on the definition and expectations of external competition for funding or investors regarding their strategy development, while, at the same time, cities tailor their individual smart city approach to their local context to tackle local challenges and specific needs (Angelidou, 2014). Since cities are extremely heterogeneous, smart city models and smart technologies can hardly be applied universally and equally to individual urban spaces. Thus, local smart city activities are always interconnected with existing social and spatial features (Karvonen, Cugurullo, & Caprotti, 2018; Shelton et al., 2015). As a result, Dameri et al. (2019) consider the smart city as a glocal phenomenon, as it is affected both by global and local environments.

3. Smart City Funding by the European Union

Since 2014, the EU has funded a total of 15 projects involving 42 Lighthouse cities that are facing diverse challenges, such as ensuring secure, affordable and clean energy, supporting smart electro-mobility and implementing ICT supported solutions (EU Smart Cities, 2019). This section gives an overview of the background and objectives of the EU funding of smart city projects across Europe in the framework programme for research and innovation Horizon 2020.

With the Horizon 2020 framework programme for research and innovation, which implements research-driven innovation within the framework of the Europe 2020 Strategy, the EU awards funding for smart city pilot projects. Aiming to enhance the EU's competitiveness on a global level, the Horizon 2020 programme focuses on promoting competitive research that supports growth, innovation—in particular so-called key technologies—and the generation of new business models (Horizon 2020, 2019). In this regard, the EU assigns an important role to cities regarding the transformation of energy systems and in meeting socio-economic challenges in Europe (European Commission, 2017). As a funding body, the EU has a specific vision of smart cities for its promotional purposes. Putting the focus on energy policies for smart cites, funded projects should aim to reduce greenhouse gas emissions through the increased use of renewable energy, improved energy efficiency in the building sector and the implementation of innovative transport systems (Vanolo, 2016). Moreover, the development of cities towards smart cities is primarily seen in connection with the use of innovative technologies and the development and innovation potentials (European Commission, 2017).

Funding calls in the area of Smart Cities and Communities have been advertised, asking for project applications from consortia consisting of different European cities and respective public and private partners. The tenders are designed to facilitate the cooperation of cities, industry and citizens to demonstrate solutions on a district scale, which are cost-effective as well as replicable at the intersection of energy, mobility and ICT (European Commission, 2016). Cities chosen to receive EU funding for a smart city pilot project are given the prestigious label of a 'smart Lighthouse city.'

Cities and project consortia that aim to design a successful project proposal must adopt this vision, corresponding objectives and regulatory requirements. Two parties of interest are thus present in this dynamic. On the one hand, the funding body—in this case the EU—awards funding to city consortia that are obliged to implement a smart city initiative according to criteria stipulated within the grant agreement. On the other hand, cities have the interest to push forward their own development objectives and to implement these through external financing. In order to successfully apply for funding, certain local development objectives have to be adapted to the specifications, goals and smart city vision of the Horizon 2020 programme.

4. EU Smart Cities: State of Research

As there has not been a national funding programme in Germany for smart city initiatives until recently, the EU Horizon 2020 funding for smart city pilot projects has taken up a driving role in setting priorities for the conception of smart city initiatives. In this context one can argue that the vision of becoming a smart city has been institutionalised in Europe through the competition for EU funding (Dameri et al., 2019; Engelbert et al., 2019; Späth & Knieling, 2018). Even if smart city projects are carried out autonomously on the local level, they can be

seen as "a subset of a larger, supranational objective defined by the EU authorities" (Dameri et al., 2019, p. 36). Consequently, it is expected that funding from the EU Horizon 2020 programme has a considerable influence on the development of smart city concepts in European cities and a number of research projects dealing with the allocation of EU smart city funding and its implication have recently been conducted.

With regard to the vision of smart cities transmitted through the Horizon 2020 programme, Beretta (2018) criticises the EU's belief in technology. Beretta maintains that the EU sees modern technologies, implemented within the smart city concept, as a solution for most urban challenges without considering critical aspects, such as a lack of social inclusiveness and possible threats to democratic structures.

Späth and Knieling (2018) see the risk that smart city projects that are implemented on the basis of the grant agreement with the EU might follow a top-down approach and possibly have a lack of democratic legitimacy on the ground. Engelbert et al. (2019) take a similar view: They criticise the fact that the perspective of citizens in EU-funded smart city projects is not sufficiently taken into account. Moreover, they claim that there are hardly any participation activities with an open outcome. The idea of the EU smart city is critically described as too management-orientated and entrepreneurial, rather than tailored to the needs of citizens. Bauriedl (2018) focuses on urban living labs as a common approach of testing the implementation of technological solutions within smart city pilot projects and criticises this format in several ways: It is claimed that the tendency of standardisation of urban development processes in such living labs does not comply with the complex social reality in cities. Moreover, solution and management-oriented approaches of setting smart city initiatives into practice tend to lead to selective research and a lack of alternative approaches and views (Bauriedl, 2018).

Haarstad and Wathne (2018) try to broaden this perspective and the views on preliminary critical studies. They claim that cities can, on the one hand, function as passive recipients of smart city projects but also, on the other hand, have the chance to play an active role in strategically taking advantage of EU grants for pursuing own interests. Instead of focusing on possible top-down mechanisms that might arise to some extent from the funding relationship with the EU, they propose to consider smart city projects as "assemblages of local and trans-local resources" (Haarstad & Wathne, 2018, p. 113). Further, the authors emphasise that cities benefit from the possibility to interpret the far-reaching smart city concept for themselves. In this way, cities can strategically allocate financial resources for the implementation of their own objectives embedded in the wide range of smart city measures.

Overall, the current research underlines that the smart city concept includes tensions that arise from the mainly innovation and technology-driven impetus on the one hand, and critical reflections on the impact of such an approach on the local democracy on the other hand. In addition to questions of how to organise innovation and motivate transformation pioneers in an intelligent way, broader discussions are opened about technological selectivity, social exclusiveness, legitimised decision-making processes and public participation of smart city strategies and related project-based concepts.

5. The Project mySMARTLife in Hamburg

In 2016, the City of Hamburg was awarded the status of an EU Lighthouse city in the framework of the project mySMARTLife. Together with Hamburg, the cities of Helsinki and Nantes also take part in the mySMARTLife project as Lighthouse cities, and the cities of Palencia (Spain), Rijeka (Croatia) and Bydgoszcz (Poland) have the role of 'follower cities.' The Lighthouse cities deploy a variety of different 'smart solutions' in the form of specific interventions that aim to reduce CO_2 emissions, promote the use of sustainable energy resources and mobility and raise the quality of life for citizens.

In Hamburg, the demonstration area of mySMARTLife is located in Bergedorf, a district with about 130,000 inhabitants. The project consortium in Hamburg has twelve partners in total, comprised of authorities, research institutions and private partners.

The specific smart interventions that are carried out in Hamburg-Bergedorf encompass four different thematic fields. In the field of mobility, the project promotes e-mobility (the purchase of electronic busses, cars and bikes). Moreover, the charging infrastructure will be expanded and new offers for car-sharing established. In the energy sector, mySMARTLife aims to foster energy-saving renovations of old buildings, the construction of innovative buildings with renewable energy and heating supply, as well as the implementation of smart home systems, smart metering and intelligent streetlights. In the ICT sector, the project focuses on the extension of the existing Hamburg-wide urban data platform and the connection with further data systems. These fields relate primarily to the implementation of innovative technical solutions at the district level. In the field of communication, mySMARTLife anticipates the implementation of engagement strategies for citizens and stakeholders as well as public relations work to foster the project's visibility and social acceptance.

6. Discussion

6.1. The EU Smart City Lighthouse: mySMARTLife between Top-Down Strategies and Local Legitimation

After outlining the relevant background knowledge, the following discussion explicitly addresses the research objective to reveal the area of tension that has arisen in the City of Hamburg with the application and permission of grants for the smart city initiative mySMARTLife. The dis-

cussion illustrates how Hamburg, on the one hand, uses project funding to advance its own development towards digitisation and CO_2 reduction and, on the other hand, operates in a competitive environment and adapts to the grant requirements of the EU. For this purpose, the complex governance structure the project is based on is examined using four categories: institutional embedding, smart city approach, actors and network and role of citizens.

6.2. Institutional Embedding

Regarding the administrative sector, Hamburg has a special role as both a city and a federal state. This implies that central public bodies have the responsibilities of a federal state, while the district's public bodies are in some way comparable to the municipal level. In Hamburg, the Office for IT and Digitisation within the Senate Chancellery is responsible for the citywide digital transformation. Thus, Hamburg's initiative to apply for grants within the Horizon 2020 smart city call also originated from the Senate Chancellery's office for international cooperation due to the mayor's priority on the topic of the smart city. After two earlier applications, Hamburg succeeded in the third attempt with its application for the Smart City Lighthouse project mySMARTLife in 2016. In order to increase the success of the application, external consultancies were engaged for the preparation of the project proposal. Thus, according to the District Office Bergedorf, responsible officials from the Senate Chancellery formulated the project contents with the support of external consultants and scientific institutions, while the district administration in Bergedorf was hardly involved at this stage of the process (District Office Bergedorf, Interview, 2018).

From a multi-level governance perspective, this is a very relevant point: Although the district government and administration are responsible for urban development issues, the project was primarily formulated at a higher administrative level. However, the subsequent responsibility for the implementation of the project lies with the district administration of Bergedorf, where a new administrative department was established to coordinate the project-related smart city activities. Due to the fact that mySMARTLife had been initiated from the administrative level above, initial tensions had risen on the part of the Bergedorf district authorities who felt ignored in the process of application and strategy development.

6.3. Smart City Approach

MySMARTLife is a demonstration project designed to test the implementation of new technologies in a mode of on-site experimentation (Bauriedl, 2018; Späth & Knieling, 2018). Such approaches are becoming increasingly common in smart city projects and can be assigned to the concept of urban experimentation (Evans, Karvonen, & Raven, 2016). An essential feature of urban experiments is "a plan giving comprehensive instruction about what has to be built, how, where and when" (Cugurullo, 2018, p. 77). In the case of mySMARTLife, the grant agreement between the EU and the City of Hamburg and the project partners as contractors, constitutes the basis for the implementation of mySMARTLife project in the District of Bergedorf. It precisely describes objectives, interventions and responsibilities for putting the project actions into practice. Consequently, from a spatial point of view, major parts of the project are limited only to the demonstration area in the District of Bergedorf. From a temporal point of view, mySMARTLife objectives are limited to the project duration. However, according to the District Office Bergedorf, there is no clear overall strategy for the consolidation and continuation of achieved developments in the long run (District Office Bergedorf, Interview, 2018). Instead of a fundamental deep transformation towards the smart city, in which binding policies and institutional changes are implemented in the district (Meijer & Rodríguez Bolívar, 2015), the mySMARTLife project is restricted to enabling the testing of individual technological solutions. Cugurullo (2018) criticises such urban experiments, as the individual fragmented measures are usually not connected across an overall concept and are therefore unable to achieve sustainable development on a larger scale.

However, the City of Hamburg aims to benefit in various ways from the sectoral and very precise practical experience gained in Bergedorf. The Senate Chancellery of Hamburg states that mySMARTLife experiences are to be transferred to other districts. Also, according to a respondent at the Senate Chancellery Hamburg, experiences will be incorporated into the political framework conditions for the entire city's digitisation and climate protection policy (Senate Chancellery, Interview, 2019). Overall, Hamburg's intention is to use external funding to implement a smart city project in accordance with EU guidelines and to incorporate the experience gained into its own strategies. This perspective is also supported by Frantzeskaki, van Steenbergen, and Stedmann (2018). The authors doubt that projects of urban experimentation could lead to transition but rather constitute a process of raising awareness how transformative change can be reached.

During the first years of the project, the strong dependency on the grant agreement has led to several challenges for the implementation of project interventions for the district authority. As the project was already conceived in the application phase a few years previously, some framework conditions have changed significantly, which make the implementation of some actions more difficult. These included economic conditions such as the low gas prices and legal changes such as a lower feed-in tariff for renewable energy from photovoltaic systems. Instead of being able to react flexibly to the current framework conditions, says a mySMARTLife partner, the project management in Hamburg had to ap-

ply for complicated contract changes with the EU in several lengthy amendment procedures (mySMARTLife partner, Interview, 2019). This illustrates the control bias of top down grants awarded by the EU. To guarantee correct spending of public money, the EU administration has set up a strict financial control system dedicated to detailed implementation indicators in the grant agreement. However, this lacks flexibility for adapting to local processes and changing framework conditions, which cannot be foreseen in detail several years ahead.

6.4. Actors and Networks

The compilation of local partners for the project consortium took place in accordance with the needs of the project covering the fields of energy, mobility, ICT and public participation. The local partners were chosen according to prior existing local connections and networks from earlier collaborations. In the selection process, it was also ensured that the content of all prescribed sectors was covered by the partners. The project partners represent authorities, research institutions and private companies (District Office Bergedorf, Interview, 2018). Bauriedl (2018) characterises such a project consortium of partners as a discourse coalition. This refers to a group of actors who are linked by a constructed storyline and give equal importance to complex social circumstances over a certain period of time. The associated actors attempt to assert their shared view of social reality on others and use it as a basis on which decisions are made (Hajer, 1993). This can happen "through debate and persuasion, but also through manipulation and exercise of power" (Hajer, 1993, p. 45).

Within the consortium, the responsibilities and tasks of the individual partners are contractually regulated with the EU. Since it is very complicated to include further partners in the project afterwards, the consortium with the key actors of mySMARTLife forms an exclusive network. During the implementation of the project, this has proved to be a difficulty in Hamburg, as in the course of the project further important partners have been identified who would have made an important contribution to the success of some interventions. According to a mySMARTLife partner, there were also difficulties, as many services had to be tendered publicly according to the public procurement regulations, and contracts could not be awarded to the project partners without further efforts (mySMARTLife partner, Interview, 2019). Here it becomes clear again which challenges the rigid and barely flexible project structure entails in the implementation of the project into practice. For the private enterprises, this limits the attractiveness to collaborate in such consortia and to bring in their knowledge. In the worst case they invest a lot in the phase of project development but lose the tender to a competitor who did not have to invest any development costs at all.

In order to share experiences gained in the project with further stakeholders in Bergedorf as well as with other district administrations and specialist authorities in Hamburg, existing coordination formats have been used and additional informal networks and exchange meetings have been established. The newly created networks aim to promote exchange between stakeholders and to provide a forum for the discussion of issues, such as innovation, digitisation and energy transformation. According to the District Office Bergedorf, the new networks can be seen as a valuable asset from which Hamburg can benefit in the long term (District Office Bergedorf, Interview, 2018).

Due do the networks between authorities, the first impulses of mySMARTLife have been discussed in broader contexts in Hamburg. This can be seen in the example of the energy assessment of new zoning plans for settlement development. From the project's experiences, the idea was discussed to consider possibilities of a sustainable energy supply in the planning process. This correlated with the Hamburg Ministry for the Environment's engagement to adopt a new regulation for zoning, which includes energy assessment of new zoning plans and is binding for planning processes in Hamburg (District Office Bergedorf, Interview, 2018).

6.5. Role of Citizens

The project mySMARTLife in Hamburg considers itself as a project in which citizens play a central role. In this context, the mySMARTLife website contains statements and project descriptions such as:

> Activities are focusing on "inclusive cities," offering a high quality of life to residents. "Smart People" are playing a vital role in their city's development.…An integrated planning process, where citizens are actively involved in the decision making, links the actions in different fields (e.g., mobility, sustainable energy, ICT). (mySMARTLife, n.d.)

However, interviews with project partners as well as observations of the authors indicate that this external presentation of the project has not completely been fulfilled in the project practice. Regarding the role of the citizens of Hamburg-Bergedorf in the project mySMARTLife, the grant agreement plays an important role again. A project partner criticises that since the project contents and the procedure had been already precisely defined during the application, there was no longer any possibility to carry out participation procedures and to incorporate the concerns of the citizens afterwards into the smart city development of the District of Hamburg-Bergedorf (mySMARTLife partner 2, Interview, 2019). Overall, the impression is conveyed that this way of proceeding in the project has the character of a rather technocratic top-down approach that does not consider the perspective of citizens in an appropriate way.

While the project partners concentrate on the implementation of the interventions, possible negative so-

cial effects on citizens in Hamburg-Bergedorf are hardly dealt with. In this regard, a project partner states that, for example, increasing rents through energetic or infrastructural upgrading would have been an important topic to consider—especially as the project names the promotion of inclusive cities as a goal. Instead of offering open-ended participation procedures, the information campaigns of the project have been more focused on seeking to create awareness and acceptance for the project goals and measures that had already been defined (mySMARTLife partner 2, Interview, 2019).

Looking at the role that citizens play in the mySMARTLife project in Hamburg, it can be summarised that the external framework conditions and specifications of the project dominate in this area and that only a little attention has been paid to the actual concerns of local citizens. This assumption can be underlined by the findings of Shelton and Lodato (2019). The authors critically note that current discourses on smart citizens hardly coincide with how smart city initiatives are implemented in practice and state that citizens at most play a peripheral role regarding power and decision-making. Also, Engelbert et al. (2019) criticise that the perspective of citizens is often neglected in smart city projects.

7. Conclusion

This article picked up the discourse of grant allocation as an instrument for smart city development and gave an insight into an actually existing smart city initiative and its implications on the local level. It was assumed that cities that receive EU funding for a smart city project have to operate in a field of tension between competing for the funding and adopting the external provisions on the one hand and aiming to use the grant strategically to pursue own objectives on the other hand. Using the example of the project mySMARTLife in Hamburg, the preceding analysis could confirm this assumption and reveals how the city acts in the framework of EU funding.

The successful acquisition of EU funding offers the City of Hamburg the opportunity to implement innovative and ambitious interventions in the field of digital and sustainable urban development in an experimental way. The analysis shows that the external influence of EU requirements is particularly noticeable in the way the smart city project has been developed and implemented. This is mainly due to the competitive procedure of applying for the grant, on the one hand, and to the rigid grant agreement that forms the contract between the EU and the project partners, on the other hand. As it precisely formulates the content and responsibilities of the project in detail, it offers very little flexibility to adapt to changing local conditions. This seems to be particularly problematic in the complex and rapidly changing environment of innovative technologies and poses many challenges to the project implementation.

A binding contract, which obliges to implement certain interventions without further involving citizens and other local stakeholders in decision-making, represents a rather old-school approach of top-down planning in urban development and there is a risk that cities will be curtailed in their autonomy of self-administration. In this regard, a more flexible funding framework would allow a more dynamic project implementation and cities could better incorporate the smart strategies within their local planning context and better involve citizens. Likewise, this could contribute to the democratic legitimacy of projects on the local level.

In the case of Hamburg as a city-state, it is also apparent that administrative responsibilities have shifted in the context of mySMARTLife, as the local level (district level) was hardly involved during the process of conceiving the project. At this point, cities should be cautious not to undermine the responsibilities and powers of action of the individual administrative and political levels.

Further, the analysis shows that smart city initiatives of this kind rather consider an experimental test field for the implementation of smart technologies than a deeper transformation to a smart city. In the case of Hamburg, the city tries to use these experiences, which would not have been gained without the project funding, and to pass them on to other districts or rather incorporate them into local strategic development objectives. As EU smart city initiatives are limited in space and time, the influence of the EU level through project requirements mainly relates to the setting in which cities test and evaluate innovative approaches and technologies. Against this background, EU funding could well concentrate on providing a creative environment for innovation instead of the described rigid steering approach. The success of the good practices will enhance the further development incrementally by being mainstreamed into local policies. Further research should explore more explicitly the structures and processes of how experimental approaches using the methodology of living labs etc. are connected with mainstream urban development policy and which obstacles and restrictions hinder the diffusion of such experiments. Then, the impact of single experiments on the sustainability performance of a city would be worth to analyse to better understand the urban innovation system and how it can contribute to achieving the requested sustainability transition on the local scale.

Finally, this study has shown that, despite certain needs for adjustment, the EU funding in the field of smart cities opens many doors for cities that support the development towards a digital and sustainable city. However, the criticisms revealed in this study also show that the EU as a funding body should rethink and adapt some of the procedural framework conditions in the competition for funding and its following implementation. The case of mySMARTLife Hamburg offers detailed insights into urban processes that connect with the broader scientific discussion on smart cities and urban transformation in the field of digitisation. Further research should make use of the group of smart Lighthouse cities to evaluate the questions of multilevel-dependencies and demo-

cratic legitimation of such approaches. This could contribute to a more reflective European innovation policy that is aware of the societal responsibilities of such developments and that integrates technological and societal innovation in a more appropriate way.

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Conflict of Interests

The authors declare no conflict of interests.

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About the Authors

Katharina Lange was a Research Associate at the Institute of Urban Planning and Regional Development at HafenCity University Hamburg. She studied spatial planning and land-use planning at the Vienna University of Technology, the Royal Institute of Technology in Stockholm and the Technical University of Dortmund. Her research interests are in the field of smart city, transformative governance and sustainable urban development.

Jörg Knieling holds the Chair of Urban Planning and Regional Development at HCU and is Dean of HCU's Urban Planning Programme. He is a member of the German Academy for Spatial Research and Planning (ARL) and the Advisory Board for Spatial Development of the German Ministry of the Interior. His main research fields are sustainable urban and regional development, spatial development and climate change, and related aspects of territorial governance and planning theory. In recent years, he has conducted several international and national research projects; previous publications include *Cities in Crisis* (2016), *Climate Adaptation Governance in Cities and Regions* (2016), *Soft Spaces in Europe* (2015) and *Planning Cultures in Europe* (2009). He has been referee of the European Commission (DG Research), the European Institute of Technology (EIT) and national research councils throughout Europe.

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Article

Mapping Platform Urbanism: Charting the Nuance of the Platform Pivot

Ashlin Lee [1,*], Adrian Mackenzie [2], Gavin J. D. Smith [2] and Paul Box [1]

[1] Land and Water Environmental Information Group, CSIRO, Canberra, ACT 2601, Australia; E-Mails: ashlin.lee@csiro.au (A.L.), paul.box@csiro.au (P.B.)
[2] School of Sociology, Australian National University, Canberra, ACT 0200, Australia; E-Mails: adrian.mackenzie@anu.edu.au (A.M.), gavin.smith@anu.edu.au (G.J.D.S.)

* Corresponding author

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Abstract
Urban planners are increasingly working with ideas around datafied cities, such as platform urbanism, to understand urban life and changes with technology. This article seeks to assist urban planners in these efforts by analysing and mapping the qualities of platform urbanism. Drawing on a dataset of approximately 100 examples that detail urban data practices, we trace some of the current tendencies that are shaping the nature and dynamics of platform urbanism. While we identify no unifying narrative or overarching pattern to our data, we interpret this as supporting Barns' (2019) notion of a pivot towards platforms. We argue this through exploring the interoperability between data sources and domains (vertical and horizontal integration), identifying elements of how platforms intermediate urban life through their growth in different sectors and the use of geolocation, and note the different artefacts that contribute to platform urbanism. We also note a concerning dynamic where city administration becomes 'locked in' to specific corporate products and interests, and thereby 'locked out' from alternatives. We discuss this in the context of social inclusion and what this means for urban planners, including the fragility of corporate platforms and what platforms urbanism means for social relationships in the city.

Keywords
data; data markets; inequality; Internet of Things; platform urbanism; smart cities; urban informatics; urban planning

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1. Introduction

Cities are increasingly being shaped by platforms, where patterns of consumption, socialising, and service provision are progressively being entwined with processes of datafication and digital platform technologies. While the idea of the 'smart city' has been widely associated with the intersection of data technologies and urban environments the unique affordances of platforms signal an evolution of the socio-technical relationship between citizens and cities. To anticipate and respond positively to these trends, urban planners must not only become familiar with urban platforms, but understand their underlying dynamics, imaginaries, and practices. This article continues to develop ideas of platforms and urban life, specifically exploring 'platform urbanism' (see Barns, 2019; van der Graaf & Ballon, 2019) and the socio-technical artefacts and dynamics that create the conditions for this system of organisation to emerge. In doing so, we respond to Barns' call to explore the 'territories of platform intermediation,' investigating how the rise of platforms are changing urban socio-spatial practices and services, and consider what urban planners might do in response to these transformations (Barns, 2019,

p. 7). We, therefore, move away from the notion of the smart city, and instead embrace the idea of platforms to explore the nuanced mixes of corporate homogeneity and socio-technical liveliness present in the contemporary city.

This article attempts to trace some of the current tendencies that are shaping the nature and dynamics of platform urbanism, using a landscape scan of approximately 100 urban data projects and their associated data practices. Our landscape scan dataset displayed no clear overarching narrative and is very contextual. We interpret this to offer support for Barns' notion of a pivot towards platform, and the re-orientation of different urban contexts towards platform technologies (Barns, 2019). We chart the interoperability between data sources and domains (vertical and horizontal integration), and highlight overlapping, and sometimes contradictory, processes of interoperability occurring between the diverse operators and users of these mediums. We also identify elements of how platforms intermediate urban life including in their growth in the public and private sector, and in the rising use of geolocation as a part of their operation. Finally, we note the three broad categories of artefacts that contribute to relationships and dynamics within platform urbanism: applications (apps), repositories, and platforms. Although there is no clear narrative or story to our data, there are patterns of data asymmetry occurring, as attempts by corporate actors to 'lock-in' their products while 'locking out' competition/alternatives mirror how the digital architecture of platforms leverages the openness or closedness of the system to generate value. We discuss this in the context of social inclusion and what this means for urban planners, including the fragility of corporate platforms and what the intermediation of platforms in urban life might look like.

2. From Smart Cities to Platform Urbanism

A sometimes ill-defined concept, the smart city broadly refers to how data technologies such as the Internet of Things (Zanella, Bui, Castellani, Vangelista, & Zorzi, 2014), Big Data analytics (Kitchin, 2014), sensors (Hancke & Hancke Jr., 2012), and pervasive Wi-Fi (Dohler et al., 2017) create what Kitchin (2014) calls 'the datafied city,' an urban space that is progressively constituted by processes of data capture and analysis. For Meijer and Bolívar (2016, pp. 396–397), datafication creates three (often siloed) visions of the smart city: (1) as instrumental applications of smart technology, (2) as places where datafication improves human capital and human outcomes, and (3) as a space for smart governance and more networked collaboration between different urban stakeholders. These visions are sponsored and promoted by corporations like CISCO and IBM, who use the smart city to propagate their corporate interests (Söderström, Paasche, & Klauser, 2014) and, in some cases, lock cities into proprietary technical solutions (McNeill, 2015). This 'lock-in' dynamic holds a community or project to a specific vendor through the implementation of path-dependent technology, while also acting to 'lock-out' the same community from alternatives.

This vision is not totalising, however. Shelton, Zook, and Wiig (2015) show many purpose-built smart cities projects fail to develop as expected. Instead, they argue, more situated and empirically based accounts are needed to capture the heterogeneity of urban dynamics and technological innovation, and the often unanticipated and diverse practices that materialise as a consequence. At a technical level, Barns (2018) makes a similar point, contending that smart cities often stage a more varied proliferation of discrete data services and data assets, rather than universal or homogenised socio-technical solutions. Although the individual nature and quality of services in smart cities vary, there is evidence of commonality. Data sharing practices and circulations are being increasingly brought together and organised through 'urban data platforms' (Barns, 2018). These platforms represent a new model of data-driven governance, characterised by different kinds of open data services—including city dashboards and data stores—that support new frameworks of urban management and public–private collaborations that capitalise on mass data flows from bodies, objects, and devices. This commonality is significant, because it foregrounds the growing influence of platforms on urban life, what Barns (2019) has described as the 'platform pivot,' as platforms emerge as a focal point for socio-technical and political economic modes of organisation in society. Platforms are not mere technical entities; they represent a unique socio-technical imaginary for enacting urban space and relations, and have significant implications for how urban planning is done.

'Platform' has a variety of definitions. The computational definition is perhaps the most common, describing an interoperable system comprising a set of stable core components or services, linked to an evolving set of peripheral or external components that have high variability (Baldwin & Woodard, 2009), what we refer to as the core/periphery relationship. For instance, Facebook is a social media platform that provides a core set of social functions, but it has also created an environment for many other digital products (such as games and advertising content) that leverages off the core functions as part of a broader ecosystem of products. The core social media services of the Facebook platform are thus associated with a diverse set of peripheral applications that are constantly changing. This is facilitated through application programming interfaces (APIs), which allow third-party complementors access to the platform. Importantly, this access is asymmetrical; peripheral third parties who use APIs have little control over the stable core of the platform, while the core service often has significant power over third parties and the peripheral environment of apps that operate off the API. The Apple iOS ecosystem is a good example of this; it is a highly varied space for application development for Apple products, where app

developers are often at the mercy of Apple for approval and distribution through the platform (Shilton & Greene, 2019). The core/periphery relationship is, therefore, central to understanding platforms. For Bogost and Montfort (2009), variability defines the character of platforms because it allows original interactions that would otherwise be impossible; for example, the use of the Twitter API by a programmer to create a data visualisation that reveals new insights. Thus, the platform is not an intermediary carriage service without influence, but rather a mediator that actively shapes content and relationships linked to it (Latour, 2005). Gillespie (2010) notes how power is central to understanding the nature and function of platforms. Tensions arise between the agency of the user and more contentious value sets at the periphery, and the core service, which dictates the digital affordances of the platform (Helmond, 2015).

While often associated with social media, platforms have expanded into many social and economic domains, creating new tensions. For instance, Srnicek (2016) identifies how platforms have become central to most business models as companies realise how data can fuel growth and attempt to capture and utilise as much of this resource as they can. The data architecture of platforms provides an infrastructure that captures the data of all who interact on the platform, leveraging the core-periphery relationship to accumulate data and, therefore, to exercise power and accumulate profit (Srnicek, 2017). Network effects, or the power/value that comes from having more connections in a network, drive platforms to spread into more aspects of life and acquire more opportunities for data. The rise of Facebook, Amazon, Netflix, and Google, and the continuous digitisation of practices varying from healthcare (van Dijck & Poell, 2016) to agriculture (Bronson & Knezevic, 2016), are ample testaments to the power of this network effect, and to a business model obsessed with accumulating, commodifying, and monopolising the means of data production (Srnicek, 2017). The obsession with data has led to massive capital investments in infrastructures of data capture, raising valid concerns about platform surveillance and the manipulation of people's everyday data (Wood & Mackinnon, 2019).

The rise of platform economies and capitalism is both a financial and ideological pursuit; it is driven by the technical architecture of platforms and the value of data accumulation, but also spearheaded through socio-technical practices such as digital 'disruption.' Urban services like Uber, Airbnb, and Airtasker are all examples of this, disrupting existing service models in favour of platforms that decentralise service providers, but connect users and providers via platforms. While economically profitable for some, these transformations also present significant social implications, including insecure work and labour conditions (Pasquale, 2016). For example, in Barcelona, the arrival of Airbnb is viewed as damaging to the culture of the city, driving up rents and displacing young citizens from opportunities (Lambea Llop, 2017). As van Dijck (2013) describes, a platform is often a constantly performed set of relationships that can set the agency and interests of one population (users, existing business holders, and communities, for example) against the platform's interests and operations (revenue generation, technical, social, or otherwise).

While discussion on smart cities has captured many of the entwinements between technology and urban life, a 'platform pivot' (Barns, 2019) is progressively occurring, as the socio-technical affordances and political-economic ideologies of platforms come to dominate the character, feel, and organisation of contemporary cities. This is not necessarily a retreat from the notion of the smart city, but a recharacterisation of urban datafication that acknowledges the unique qualities and situations—but also growing potency—of platforms (Leszczynski, 2019). Van der Graaf and Ballon (2019) argue this uniqueness lies with how platforms conjoin commerce and community through the intersection of participatory technologies and practices, datafication, sharing environments, and cultures, and the multi-sided market that platforms create. Barns (2018) places platform urbanism in the context of urban data platforms, a range of data infrastructure that supports city governance and operation, including data warehouses, data marketplaces, and data showcases. The development of urban data platforms reflects the emergence of a new organisational logic concerned with managing and governing the city, with different urban data platforms embedding varied expectations and organisational content into civil, commercial, and citizen interactions. For Barns (2019) this makes the city less 'smart' as the affordances of platforms are tied to their often proprietary nature. The proprietary and highly commercial nature of platform urbanism is further highlighted by Caprotti and Liu (2020), who regard platform urbanism as linked to specific corporate, technological, and spatial geographies. While the role of corporations is often raised in the literature, Caprotti and Liu (2020) highlight the role of government in enabling platform urbanism; for example, Chinese state authorities are heavily invested in the development of urban data platforms. However, this may be related to the Chinese government's more centralised and authoritarian style of governance—its surveillance activities have benefited significantly from centralised data collection programs. Despite the variances illustrated above, there is a common interest in data, the intersection of data, and how urban life is increasingly animated and staged across platform types and geographies.

In line with the above discussion, we understand platform urbanism as the configuring of urban space around platform architectures that emphasise increased forms of data capture, programmability, automation, and third-party value generation (Helmond, 2015; Plantin, Lagoze, Edwards, & Sandvig, 2018). For example, the urban data project proposed by Sidewalk Toronto involves a data infrastructure that allows urban data to be captured through a variety of sensors, with data amalgamated

in a unified environment in which third-party innovations can occur (including artificial intelligence), creating value for the city (improved livability) and complementors (third parties who use the platform's data for innovation, services and products). Sidewalk Toronto is more than just a specific set of infrastructures or data collection tools that dataify and provide specific functions, but an overall structure that leverages a multitude of data through an integrated environment and marketplace. These structures facilitate the simultaneous 'opening up' and 'closing down' of diverse markets, services, and practices in quite sophisticated ways.

Our point of departure from this discussion is the need for deeper engagement with the specific sociospatial practices and services that are evolving in the wake of platform urbanism, and the different dynamics of interoperability between artefacts that operate alongside the logic of platforms. We noticed that many corporate actors are engaged in 'locking-in' urban spaces and communities to their platform products, while 'locking out' the possibility of alternatives. Unlike smart cities projects, platform urbanism amalgamates discrete urban data practices in both a centralised and decentralised fashion, so that various forms of urban activity (historical, actual, and speculative) can be better known and coordinated through a centralised point—the platform. In doing this, the platform simultaneously affords differential levels of openness, access, and service—depending on who or what is using them and what access rights and privileges they are granted. This brings service providers, users, and third-party complementors together in quite asymmetrical ways. It permits a fixed core to interact with a variable periphery linked together via interoperable data relationships. Our contribution to understanding platform urbanism is to situate and illustrate this dynamic in the context of existing data practices in the city, responding to Barn's call to explore the 'territories of platform intermediation,' and the nuances of how platforms shape urban space and living (Barns, 2019, p. 7)

This analysis becomes important, as models of platform urbanism progressively cement themselves at the core of urban life. Plantin et al. (2018) observed that platforms are increasingly melding with—and transforming—existing urban infrastructure (see Table 1 for the qualities of platforms and infrastructure), revitalising the configuration of key urban services. This entails the platformisation of infrastructures, where public utilities are splintered into private services that are underpinned and controlled by private interests, and the infrastructuralisation of platforms, which give platforms the stable characteristics of—and appearance of being—public infrastructure. For infrastructuralised platforms, this includes responsibilities for providing long-term, standardised, scaled, and fundable services to large bodies of users, while also existing as an architecturally dispersed and capital-driven enterprise. While not exploring smart cities directly, Plantin et al.'s (2018) observation is evident in projects like Sidewalk Toronto, where Alphabet-owned Sidewalk Labs will provide the infrastructure for this urban space through the strategic deployment of its own private and for-profit technology, generating concerns around privacy, security, and in/equitability (Cecco, 2019).

As these architectures become more prevalent, and integrate more sources of data and human activity into their enclosures, critical questions must be asked to address platform urbanism and the cultures of capture, programmability, modulation, and value-generation its in-

Table 1. Infrastructure and platform properties.

	Infrastructure	Platform
Architecture	Heterogenous systems and networks connected via sociotechnical gateways	Programmable, stable core systems; modular, variable, complementary components
Relation between components	Interoperable through standards	Programmability within affordances; APIs
Market structures	Administratively-regulated in public interest; sometime private or public monopoly	Private competitive, sometimes regulated via antitrust and intellectual property
Focal interest	Public value; essential services	Private profit; user benefit
Standardisation	Negotiated or de facto	Unilaterally imposed by platforms
Temporality	Long-term sustainability; reliability	Frequent updating for competitive environment
Scale	Large to very large; ubiquitous, widely accessible	Small to very large; may grow to become ubiquitous
Funding	Government; subscription; lifeline services for indigent customers; pay-per-use (e.g., tickets)	Platform purchase (device), subscription (online), pay-per-use (e.g., TV shows); advertising 'Opt in,' for example; choosing one platform instead of another; creating mashups

Source: Reproduced from Plantin et al. (2018, p. 299).

termediations facilitate. The sheer variability and scale of platforms, and the complexity of their social and technical arrangements, however, make any attempt to precisely and coherently summarise core facets challenging. While interoperability is a goal of many platforms, the social scripting and situatedness of technology means the operating reality of these entities is governed by contextual factors and circumstances, such as the technical components and operating cultures of the systems (Latour, 1996). Further, platforms are often connected to other platforms, forming what van Dijck, Poell, and de Waal (2018) call 'platform ecosystems,' which are heterogeneous assemblages of different platforms. Therefore, the first step to understanding the nuance of platform urbanism requires a means of categorising and mapping the variation in platforms themselves, and the underlying dynamics and processes existing between the different actors and arrangements in question. It is to this task that we now turn.

3. A Reference Dataset for Platform Urbanism

As part of a broader project on smart cities and equity in data economies and urban data markets, we conducted a 'landscape scan' of smart cities projects and initiatives (see the supplementary file for a full breakdown of examples scanned). Landscape scans are commonly used to strategically review programs or entities that exist within a specific context, for the purposes of business intelligence. This process is not meant to conduct deep, theoretical analysis of specific examples, but instead to establish the general trends and insights that can inform future practice. Three criteria were used to sample examples for the urban data market datasets:

1. Examples must be urban- or city-based;
2. Examples must involve data as a primary component;
3. Examples should attempt to share, circulate or otherwise mobilise data.

Using a snowball sampling approach (where each example guided us to find other relevant examples), we gathered relevant examples of initiatives, services, policies, projects and products explicitly labelled as 'smart city/cities.' We also included significant platforms, applications, and technologies that contribute to the realisation of smart city vision based on the inclusion criteria. We aimed for some global diversity, variations in scale and social setting, modest historical depth, and a mixture of the exotic and mundane.

The resulting dataset (see the Supplementary File), characterised by great heterogeneity, was then mapped against a set of general assessment criteria (see Table 2) synthesised from several different sources. Technical categories—such as the hardware and software environment—were drawn from the Reference Model for Open Distributed Processing (RM-ODP; Box &

Table 2. Assessment criteria.

Architectural Viewpoint	Dimension	Element	Source (adopt/adapt/invent)
Social	Social	Motivations for providing data; data providing users relationship with platform and its operators; scale and extent of providers and users	Invented
	Institutional	Governance; stakeholder engagement; ownership (drivers of the initiative)	Adapted from Schreieck et al. (2016) and Lee et al. (2018)
	Economic	Business model; incentives for engaging with the platform sharing data	Adapted from Plantin et al. (2018), Langley and Leyshon (2017), and Lee et al. (2018)
Technical	Core and periphery	Core components; peripheral (application components); functions provided by each	Adopted Lee et al. (2018)
	Channels for data capture	Sensors	Adopted Lee et al. (2018)
Informational	Sources of data	Where does the data come from	Invented
	Theme of data	Smart cities domains addressed by the case study	Adapted from IoT and smart cities literature
	Scale and scope of data (and users)	Global, national, city, subcity	Invented
	Data as primary value exchange or bi-product		Adapted from Schreieck et al. (2016) and Lee et al. (2018)

Lemon, 2015). This model proposes five viewpoints in the management of distributed information systems: enterprise, information, computational, engineering, and technology. These viewpoints were collapsed into three architectural perspectives: social (enterprise viewpoint), informational (information viewpoint) and technological (computational, engineering, and technology viewpoints). Building on the framework from Box and Lemon (2015) the social perspective was expanded to include social (cultural and social practice aspects, including values, norms, and ethics), institutional (governance, decision structures and rights, and other institutional elements), and economic (incentives, value drivers, business model, etc.) dimensions. Given our interest in how data markets and platforms are configured, we also drew on recent interdisciplinary literature on platforms and data markets to analytically develop these categories (see Langley & Leyshon, 2017; Lee, Zhu, & Jeffery, 2018; Plantin et al., 2018; Schreieck, Wiesche, & Krcmar, 2016). Results were synthesised using a design thinking methodology, as part of broader project deliverables such as apps and reports that are outside the scope of this article.

Analysis of the landscape scan dataset focused on counting and cross-tabulating examples. We used these counts to augment and adjust the dataset. If a particular count was low (for instance, examples in South East Asia or health-domain apps), we searched for more. If a particular count was too high, we reflected on the categories and sometimes refined them (by either adding new categories or perhaps new forms of classification). The process of creating such a reference dataset was potentially open-ended. Analytically, we regard this counting and tabulation of examples (see Tables 3 to 8) as ways of grounding the dominant narratives or representations of the somewhat free-floating concept of the smart city. Including more examples in understanding the smart city, especially mundane or low-profile examples, diversifies the concept. The counts and tabulations of examples inevitably flatten and reduce their lived complexities. However, the numbers can also deflect the insistent bias of power-laden conventional narratives.

There are limitations to this approach. Snowball sampling of public materials limited the scope and depth of examples. Publicly available information does not always capture the contexts of examples and might therefore be biased. Different team members coded the landscape scan; they may have potentially used different frameworks of assessment and understanding. Our criteria for classification, even at basic levels such as geographical location or social sector, were often difficult to apply and we struggled to consistently categorise what we were seeing despite multiple iterations through our 100 examples. We acknowledge these limitations vis a vis more in-depth methods such as ethnography or even discourse analysis, but believe it still has merit. If nothing else, it presents the breadth and diversity of smart cities initiatives and their relationship to the notions of data markets. We suggest that some of the difficulties in sampling and analysing smart cities as processes of social transformation also derive from the shape-shifting practices of platform urbanism. As sociologist Howard Becker writes, 'phenomena seldom have all the attributes required for them to be, unambiguously, members of a class defined by multiple criteria' (Becker, 2008, p. 177).

4. 'The Pivot': From Smart Cities to Platform Urbanism

The landscape scan of smart cities shows no overall trend in the tabulated data, despite our efforts to find one. This null finding is not without interest. The collection of activities subsumed by the smart city, and the shifting composition of these activities, can be understood as an ongoing 'pivot'—a change of plans triggered by altered circumstances. This is first identified by Barns (2019), who suggests smart cities have pivoted using platform technologies, into what is previously described as platform urbanism. While identifying this general trend, the impacts and qualities of this pivot are unclear (Barns, 2019). Our results support Barns' (2019) theoretical observation and contribute towards elucidating the qualities of this pivot. We observed a pivot to platform urbanism in the dynamics of vertical and horizontal integration processes (defined in the following sections), and the amalgamation over time of urban data practice into the core-periphery relationships typical of platform configurations. Patterns of differential access and the lock-in/lock-out issue were also observed. But this is not a well-structured architectural transformation. Notwithstanding the many visions of integration we encountered, the landscape scan points to plurality, overlaps, provisional compromises and temporary fixes, and a constantly receding horizon of promise.

The amorphous character of the smart city is illustrated by geographical distribution of examples in the dataset (Table 3). Several spikes appear in the geography of the landscape scan. Many examples appear in a specific city (Kansas Smart City, Switching on Darwin, Sounds of New York City, Sydney Coordinated Adaptive Transport System), and 70% of examples were associated with specific cities or were nationally scoped platform or app offerings from vendors (see Table 3). The remaining 30% of examples have a global scope and are not

Table 3. Geographical distribution of examples in the landscape scan.

Geography	Count
Global	34
Multiple cities	25
Single city	22
National	18
Region	3
Neighbourhood	3
Dwelling	3
Unknown	1

Table 4. Vertical integration.

	Verticality of smart cities technology	Count	Examples
A	Platform only	29	ATandT Data Flow, IBM Watson, Microsoft
B	Sensors + Platform	54	CISCO Kinetic, Nokia Impact
C	Physical Infrastructure + Sensors + Platform	16	Bosch, Huawei, Microsoft, Telstra
D	Physical Infrastructure + Sensors	4	Smart fridges, air-conditioning
E	Sensor only	2	Analog Devices, Siemens Mindsphere, Philips
F	Infrastructure	2	Not considered, i.e., not 'smart'
G	Unknown/unclear	2	

tied to any particular city or local geography. These often more recent examples represent smart city idealisations and models of multinational technology vendors, or other service offerings that could be used anywhere. Examples range from Uber, to Pokémon GO to the Huawei City Platform.

4.1. The Spaces of Interoperability: Vertical and Horizontal Integration

Given the varying scale of examples, it is not surprising that we observed interoperability to be a key element of platforms. Without institutional, technical, and informational interoperability, a platform cannot generate the network effects around data that create value, or facilitate interactions between diverse sets of social and economic actors. We observed two kinds of interoperability—horizontal and vertical integration—within urban spaces that contribute to this. Vertical and horizontal integration refers to the ways in which information systems become more interoperable and interconnected in form and practice. Vertical integration refers to the coupling of socio-technical elements across the layers of physical and digital infrastructure that enable the capture, storage, and exploitation of data. Platform architectures have evolved 'stacks' that arrange and connect layers of technical elements. Our analysis shows a tendency towards greater vertical integration, replacing localised interfaces and targeted data sources with mass data collection flowing through platforms. We identified three categories of interfaces relevant to vertical integration: sensors (air, pollution, and water quality, for instance), physical infrastructure (such as smart lighting systems or roads), and platforms (data amalgamation and analysis services). As Table 4 shows, most smart cities examples feature some kind of interface between sensors and platforms, explicitly pairing urban data sensing with further analysis and operation by third parties, often through various types of automation.

The scope of data capture is also growing through horizontal integration, as Table 5 shows, with multiple fields of data associated to these platforms. Examples were assessed against all six domains to explore horizontal integration, resulting in multiple examples being coded to each criterion. A grand total is therefore unhelpful here. Horizontal integration refers to the expansion of data capture into different domains of human activity, and the integration of data from different sources and activities into platforms. Table 5 lists the specific scopes and domains of data collection we observed. Many smart cities examples no longer address a specific problem with specific data. Rather, they gather and accumulate data across domains, to anticipate and capitalise on diverse problems and possibilities yet to emerge. This shift in logic expands the remit of the smart city, in line with what Boyd and Crawford (2012) describe as one of the underlying mythologies of Big Data: that collecting all data (N = all) is desirable—necessary even. This is evident in the increasing practice of collecting geolocation data, with Table 7 indicating most surveyed platforms use geolocation tracking as a default feature of their operation.

Table 5. Horizontal integration.

Data scope	Count
Economy	28
Environment and energy	28
Government and education	30
Living and health	43
Safety and security	24
Mobility	51

The combination of these interfaces and data sources generates the pivot dynamics central to platform urbanism. The strata of urbanised platforms multiply and spread as smart cities pivot towards an ideal of agile entrepreneurial governance animated by metrics, experiments, models, dashboards, and continuous redeployment (Coletta & Kitchin, 2017).

4.2. Territories of Intermediation

The use of platforms attests to steady growth in the markets for smart city products. This tends to creat the lock-in/lock-out dynamic. The platforms we observed to be growing in the domain of smart cities are primarily products created by corporate actors (Table 6). The earlier pre-eminence of governments and communities active in the smart cities domain subsides and, in recent years, private sector entities were the most dominant. Given that public sector entities often require the support of private vendors to initiate and deliver platform

projects, we believe that many recent public projects also have a private sector dimension. As discussed earlier, smart cities implementors are incentivised to use proprietary technology to bolt clients to their products. For example, Huawei (2019) provides a 'holistic set of [smart city] ICT solutions featuring a "cloud-pipe-device" synergy.' This connects multiple kinds of devices (personal smartphones, sensor networks, smart infrastructure) that collect a multiplicity of data, displaying the vertical and horizontal integration described previously. It also functions to lock urban data and technologies into this environment by creating technological momentum (Hughes, 1994) that keeps the city beholden to the platform. This includes the significant capital cost of set-up and installation—which, as McNeill (2015) noted, is sometimes waived to surreptitiously compel cities to continue using the platform due to the high initial cost—and the ongoing costs of having appropriately trained staff and expertise to operate the system. This prevents alternative vendors from engaging in this entity, creating the aforementioned lock-in/lock-out dynamics.

Table 6. Sectoral distribution.

Sector	Count
Private sector/technology product	52
Government project	26
Civil society	26

Table 7. Use of geolocation.

Use of geolocation	Count
Yes	59
Not Sure	45
No	5

4.3. Artefacts of Platform Urbanism

The dynamics of platform urbanism are created through a variety of services, products, and technologies—what might be thought of as the artefacts of platform urbanism. Combinations and relationships between and through artefacts (such as the interoperabilities previously discussed) allow effects like the lock-in/out dynamic to occur. For example, platforms such as IBM's Intelligent Operations Center for Smarter Cities can lock cities into centralised, and often privately operated, platforms. In doing so it can decontextualize data from urban environments and open data up for use by third parties, creating different kinds of products and services that affect urban life.

We identified three broad kinds of artefacts that contribute towards the platform pivot: applications (apps), repositories, and platforms (Table 8). Each artefact is a general category that can be used to understand the underlying nature of the examples we explored. Our classification of these examples derives from an interpretation of which artefact represents each example in our dataset.

Apps offer the platform environment of smartphones, such as the Apple iPhone or Google Android, a foothold on urban life. Although literature on smart cities has often focused on distributed hardware and software installations, we believe apps are important because of the distributed data-driven contribution they make to urban living. Apps carry the mundane tracking, capture, measurement, and communication operations that precede and underpin much platform urbanism by capturing metrics on the movement patterns of citizens to the metadata of communication in the city, contributing to liveability and the scripting of social relations. They prepare the foundation for platforms. For instance, from a pedestrian's perspective, apps superimpose data-driven interactions with a cyber-physical urban realm, such as through forms of recommendation (such as FourSquare) or site-specific entertainment and localised social interactions (like Pokémon GO or Grindr). Data generated through app interactions becomes a source of direct or indirect value at the platform level; for example, transport-as-service platforms like Uber generate value from creating a marketplace through the apps that connects third parties and enables new value to be generated from these transactions. The data from these exchanges can also be used as a source of value for the parent company. As a form of vertical integration, these apps unite the sensor and interface affordances of devices with decentralised software platforms that create geolocationally relevant and unique experiences for users, and provide this data to parent companies and third parties who add/derive value to/from it, matching characteristics of platform urbanism.

Table 8. Artefacts in platform urbanism.

Artefact	Count
App	32
Repository	31
Platform	28
Other	18

Repositories are organisationally grounded centres of urban data storage and access, where data is centralised to enable decentralised value generation. According to Barns (2018), they are portals for machine-readable government data that seek to create innovation and transparency through providing centralised, but also de-institutionalised and democratised, access to city data. Using standardised metadata, repositories enable different kinds of data to be stored and accessed thus enabling horizontal integration and potentially leveraging developments in vertical integration. Third parties are invited to create value from data collected about urban life and stored on repositories by downloading and using it, as repositories typically do not provide analy-

sis functionality. Third parties, therefore, decontextualize the data away from its original context, creating different kinds of products and services as a result. This process is not inherently exploitative; for instance, the Chicago Data Collaborative is a repository of criminal justice data, adopting a cooperative model amongst members to store data for social justice causes.

Platforms are initiatives consistent with an earlier definition of platforms and their variable core/peripheral relationships. Large smart cities projects, such as Sidewalk Labs Toronto, adhere to this definition, providing a full socio-technical architecture that captures, stores, and analyses data, creating value for individuals and consumers. Platforms are more sophisticated multistakeholder or multisided entities, with the ability to collate, aggregate, integrate, and use multiple streams of data simultaneously. These projects are generally the domain of large technology companies, such as CISCO and IBM, due to development and deployment costs. They also reflect corporate interests and understandings of value, rather than community or ground-up visions. Their interfaces with city governance are uncertain and still taking shape.

While we have sought to highlight platform urbanism as the salient trend, the close integration of apps and repositories into the lived experiences of users takes platform urbanism into more socially situated spaces. Apps and repositories territorialise at the street and organisational level, respectively, evoking different data flows to create a varied and lively data ecosystem that, while coherent with the platform pivot is also nuanced.

5. Discussion

Platform urbanism, like the smart city before it, will likely be associated with a utopian promise of greater emancipation through data-driven insights and economies. While potentially true, it is important to not ignore the challenges and contradictions revealed by the nuances of the platform pivot. Two major, interrelated issues stand out from our analysis: (1) the agility and fragility of the platform pivot, and (2) the quality of intermediation (or the nature of socio-technical relationships under platform urbanism).

The idea of the pivot comes from business strategy and management literature, which emphasises the need for firms to flexibly re-orientate themselves in the face of market/user/customer change (Trimi & Berbegal, 2012), an increasingly popular trend that dovetails with technology-centric management methodologies such as 'lean' and 'agile' (Bosch, Olsson, Bjork, & Ljungblad, 2013). Our data supports the existence of a pivot, as the geographical distribution (Table 7), and vertical and horizontal integration metrics (Table 4 and Table 5) illustrate the movement towards platform systems across a variety of spatial areas and practice domains. The identification of the dual lock-in/lock-out dynamic of these platforms, however, makes us question whether this pivot is agile or is it more of a fragile entity? Horizontal and vertical integration indicate large volumes of data are available across multiple sectors. This suggests an ample volume of data for platforms to use and facilitate the platform pivot. If there is so much data being produced across so many sectors, why lock down communities? Locking down users and communities to platform products suggests, however, that solutions being provided by corporate technology providers are far more fragile than providers would have us believe. Despite the abundance and spread of data, there may be underlying issues making platforms vulnerable. We believe this may lie with a failure to understand the heterogeneity of urban life. Interoperability is vital to platforms because it ensures commensuration, allowing differing things to connect across contexts. Platforms use technical systems like APIs to allow different technologies to integrate, but it does not imply that social contexts will interoperate. The diversity of artefacts and contexts in which they operate (as identified above) means that for urban platforms to be realised, interoperability must be maintained against constantly active technical and social spaces—some of which may resist or disagree with the directions of corporate platform urbanism. The lock-in/lock-out dynamic is, therefore, a way of forcing interoperability to occur at a technical level, because the social reality of the city is more diverse than corporatised platform pivots expect. Furthermore, the idea of pivots and organisational agility don't fully capture the obduracy of some urban socio-technical elements. This may include institutions, persistent socio-demographic deficits like poverty, or the physical environment. A pivot cannot occur without a fixed point; urban planners should be wary of fetishizing change, and missing those anchors that hold a platform together.

Building on the diversity of platform urbanism, and reflecting on the needs of urban planners to address the challenges of the city, the second issue we identify relates to the quality of socio-technical intermediation occurring in the city, and how urban planners might respond to this. What we refer to here is the nature of relationships occurring as a feature of platform urbanism, and that planners should be mindful of these relationships in how they understand urban issues. The diversity of artefacts, contexts, data sources, and practices identified suggests that the quality of intermediation a platform provides is more variable than suggested by private sector vendors. For example, projects such as the Common Sense program (Aoki et al., 2008) the Amsterdam Smart Citizens Lab (Jiang et al., 2016), and the Connected Sustainable Cities project (Gabrys, 2014), are examples of citizens using environmental sensors that are vertically integrated with a platform to create new kinds of social value, including contributing to better environmental outcomes and new practices of community informed urban governance. Many smart city vendors are private sector entities, whose vision of private profit contributes to the lock-in/lock-out charac-

ter of platform urbanism that we observed. While platform capitalism (Srnicek, 2017) has configured many platforms to target new 'domains of circulation' (Langley & Leyshon, 2017), there is potential for platforms to create new kinds of social and community value that urban planners could use to achieve social justice outcomes. Urban planners should therefore not accept homogenised visions and articulations of platform urbanism, as these ignore the social and technical diversity at play. As our results indicate, the reality of the smart city is one defined by considerable diversity and flux. Urban planners should thus consider the socio-technical dynamics inherent to relationships in the city, and how these can be used for making better design decisions and social policy formulations, rather than accepting any pre-existing template of the smart city that is driven predominantly by economic imperatives. For example, interoperability between diverse sets of artefacts suggests not only that data might be aggregated up into centralised platform architectures, but with the right configuration may also be pushed back down to users as civic resources. Studies of mobile technology users have demonstrated the incredible scope of apps and smartphone to create communities (Goggin & Hjorth, 2014), even amongst the most disadvantaged groups in society, such as refugees (Gillespie, Osseiran, & Cheesman, 2018). This illustrates how it is possible to interoperate diverse socio-spatial communities and practices while recognising the uniqueness of contexts. This may occur through opening up platform architectures socially and technically. Just as good urban planning co-design developments with communities, the same can—and should—be done with platforms. The APIs and technical architectures of platforms can also be configured to grant greater openness to those involved in the periphery, allowing them a greater voice in the form of platform urbanism being created. This embraces the diverse demographic and infrastructural constitution of smart cities despite powerful institutional actors and actions.

Building on this and our data, we also suggest that part of the quality of intermediation occurring under platform urbanism is one that is incoherent. This is a reality that urban planners must acknowledge and embrace, rather than resist or deny. While noting the dynamics of interoperability, we observed no overarching story or narrative that can easily capture all the relationships and dynamics of platform urbanism. We acknowledge that our approach is distinctly limited, and we may not be capturing enough to make this judgement, but it could also be that easily fitting narratives are not present in contemporary datafied cities. While there are socio-technical hegemonies of platform and surveillance capitalism (Srnicek, 2017; Zuboff, 2015), neo-liberalism and political-economic uncertainty (Harvey, 2007), and stark social divisions, perhaps the reality of modern cities is one of incoherency, as both social groups and individuals attempt to make sense of socio-technical change that far outstrips understanding. For planners this means not attempting to impose singular understandings of urban life, and instead committing to a richer, more pluralised and deeply contextual view of urban relationships. Having an awareness of coherency is also not an excuse to divest from strategic and critical thinking. Planners should continue to be wary of how platform urbanism might reinforce disparities based on demographic characteristics such as income and geolocation (Brannon, 2017; Galdon-Clavell, 2013), and the continuing concerns about how data are collected, stored, used, and shared in the provision of services (Elmaghraby & Losavio, 2014) where some parties struggle to opt in due to a lack of resources, while for others, opting out is impossible. We must not lose sight of how platform urbanism might positively and negatively affect a citizen's quality of life and social participation, through the material practices and idealised discourses that are connected to the platform (Kitchin, 2016).

6. Conclusion

Platform urbanism presents a unique opportunity for urban planners, providing a new socio-technical canvas for urban development. The lack of a significant trend in our data indicates the limitations of the smart city concept, and the value of platform urbanism in capturing the liveliness of digitally enabled urbanism. While messiness is analytically not the most pleasant result, it does reflect the lived city more adequately, with its diverse demographics and thus heterogeneity of need and practice. Urban planners should therefore view this as an opportunity to both engage with the messiness, and perhaps create their own 'mess' in the process by experimenting with a localised, platform urbanism that engages more concretely with the situated needs of citizens. Underlying dynamics of interoperability, and associated relations of (fr)agility and intermediation, are levers that can be manipulated by planners in their mess-making. This builds on Leszczynski's (2019) observation that platform urbanism is incomplete and prone to malfunctions, yet it is these malfunctions or 'glitches' that allow resistance and innovation to materialise. Such mess-making endeavours by urban planners would serve as a helpful counterbalance to the oligarchical and centralised power structures critics have observed. Although powerful and potentially inequitable, embracing the incoherency and messiness of platform urbanism might be a helpful step in creating new and more vibrant urban spaces.

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Conflict of Interests

The authors declare no conflict of interests.

Supplementary Material

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

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About the Authors

Ashlin Lee (PhD) is a Social Architect at CSIRO and an Honorary Lecturer in Sociology at the Australian National University. With a background in digital sociology, he provides sociological and social science insights to assist in the development, deployment, and optimisation of information and data systems. His work has been published in *Information, Communication and Society*, *Sociology Compass*, *Surveillance and Society*, and the *Journal of Sociology*. He has worked in academia, public service, user research, and digital transformation roles.

Adrian Mackenzie (PhD) is Professor of Sociology at the Australian National University, and a leading scholar of science and technology studies. His current interests focus on network and computational media, digital sociology and innovation in data-related methods. He is the author of *Machine Learners: Archaeology of a Data Practice* (2017, MIT Press), and has recently published on the capitalization of online platforms, device-specific events, consumer genomics, and DNA-based biosensing. He also co-edits the journal *Big Data and Society*.

Gavin J. D. Smith (PhD) is Associate Professor of Sociology at the Australian National University. His research looks at the social impacts of digital technologies, data practices and dataveillance across a variety of domains, as well as exploring social relations on the nature-culture borderland. He has published extensively on surveillance practices and politics in journals such as *Body and Society*, *Big Data and Society*, *The British Journal of Criminology*, and *Theoretical Criminology*. He is the author of *Opening the Black Box: The Work of Watching* (2015, Routledge), which is based on an ethnography of CCTV camera operators.

Paul Box is a Principle Research Consultant and Social Architect at CSIRO, and leads a team that is researching and designing social, institutional and economic dimensions of Information Infrastructure and platforms; what the team calls Social Architecture. Paul has worked for more than 25 years in geospatial information technology, including with the UN, and NGOs in Asia, Europe, and Africa. He has, for the last 10 years, worked with CSIRO across information infrastructure projects of national significance.

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Article

How Does ICT Expansion Drive "Smart" Urban Growth? A Case Study of Nanjing, China

Zipan Cai [1], Vladimir Cvetkovic [1] and Jessica Page [2,*]

[1] Department of Sustainable Development, Environmental Science and Engineering, KTH Royal Institute of Technology, 100 44 Stockholm, Sweden; E-Mails: zipan@kth.se (Z.C.), vdc@kth.se (V.C.)
[2] Department of Physical Geography, Stockholm University, 106 91 Stockholm, Sweden; E-Mail: jessica.page@natgeo.su.se

* Corresponding author

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Abstract
In the context of accelerated urbanization, socioeconomic development, and population growth, as well as the rapid advancement of information and communication technology (ICT), urban land is rapidly expanding worldwide. Unplanned urban growth has led to the low utilization efficiency of land resources. Also, ecological and agricultural lands are continuously sacrificed for urban construction, which in the long-term may severely impact the health of citizens in cities. A thorough understanding of the mechanisms and driving forces of a city's urban land use changes, including the influence of ICT development, is therefore crucial to the formation of optimal and feasible urban planning in the new era. Taking Nanjing as a study case, this article attempts to explore the measurable "smart" driving indicators of urban land use change and analyze the tapestry of the relationship between these and urban land use change. Different from the traditional linear regression analysis method of driving force of urban land use change, this study focuses on the interaction relationship and the underlying causal relationship among various "smart" driving factors, so it adopts a fuzzy statistical method, namely the grey relational analysis (GRA). Through the integration of literature research and known effective data, five categories of "smart" indicators have been taken as the primary driving factors: industry and economy, transportation, humanities and science, ICT systems, and environmental management. The results show that these indicators have different impacts on driving urban built-up land growth. Accordingly, optimization possibilities and recommendations for development strategies are proposed to realize a "smarter" development direction in Nanjing. This article confirms the effectiveness of GRA for studies on the driving mechanisms of urban land use change and provides a theoretical basis for the development goals of a smart city.

Keywords
grey relational analysis; ICT; land use change; smart city; urban planning; urbanization

Issue
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1. Introduction

The world is currently undergoing tremendous change, and the significant progress in information and communication technology (ICT) increasingly convinces us that the era of smart city has already arrived (Karvonen, Cugurullo, & Caprotti, 2018). The upgrading of traditional industries driven by digitalization, especially in the manufacturing, commerce, and service industries, has brought about structural change (Loo & Wang, 2017). The ubiquitous network of information infrastructure, as well as the services it provides, have redefined the con-

cept of location, while the elements of a city that are affected by the information infrastructure have reshaped the form, space, and texture of a city as a whole (Bibri & Krogstie, 2017; Chourabi et al., 2012; Graham, 2002). The concept of a smart city aims at the integration of ICT and other new technologies and services to promote smart urban growth; this concept has been placed on the development agenda by policymakers around the world since it was first proposed in the early 21st century (Neirotti, de Marco, Cagliano, Mangano, & Scorrano, 2014). However, due to the different characteristics and needs of urban development in different countries and regions, there is no uniform definition and implementation route for a smart city, for example, some cities focus on "smartness" through electronic intelligence, while others might focus instead on promoting high-tech industries (Albino, Berardi, & Dangelico, 2015). Empirical research shows that the evolution and development of a smart city are highly dependent on its local socioeconomic factors, including industry, economy, transportation, energy, environment, infrastructure, people, and governance (Makushkin, Kirillov, Novikov, Shaizhanov, & Seidina, 2016). Although the international debate on the development of smart cities is still ongoing, one fact has been recognized as universal—the application of ICT in all areas of a city can help to improve the efficiency of resource utilization, urban management, and services, and ultimately to improve the citizens' living quality (Albino et al., 2015; Allwinkle & Cruickshank, 2011; Batty et al., 2012). As highlighted by today's smart city advocates, ICT will eventually bring together the various service functions of a city into a diverse, complex, interconnected, and manageable system (Cocchia, 2014; Ergazakis, Metaxiotis, & Psarras, 2004). In such a context, how should urban planners incorporate ICT and the concept of a smart city into their development strategies, given the unknown impact of ICT?

The advancement of ICT presents enormous challenges in medium- and long-term urban land use planning, as it improves the information interaction nodes, modes, and systems of cities from different scales, such as urban infrastructure, building, public space, and environmental elements (Hernández-Muñoz et al., 2011). ICT also has an interwoven influence on travel behavior, reflected in the guiding role of ICT in specific travel decisions, such as population mobility activities, travel means and supplies, and citizens' lifestyle and location decisions (Mokhtarian & Tal, 2013). Therefore, small decisions about ICT development may have a significant impact on the size of the city, especially in terms of urban land expansion (Maeng & Nedovic-Budic, 2010). Urban planners need to be aware of the potential impacts of ICT development of urban land use so that they can make informed, forward-looking planning decisions. If today's urban land use can be understood as the combination of land resource utilization and urbanization, then the concept of a smart city can be understood as the integration of digitalization and urbanization (Anthopoulos & Vakali, 2012). Studying urban land use changes from the perspective of smart city development means an indirect integration between digitalization and land use, which aims to help us explore how the development of ICT promotes the evolution of urban land use. Therefore, as the main driving force for the development of information society, ICT construction and management should be considered as a new aspect of urban planning.

Recent studies have attempted to systematically analyze the link between urban land use changes and the effect of ICT development, with the aim of helping urban planners and policy makers to understand the controllability of urban expansion (Chen, Chang, Karacsonyi, & Zhang, 2014; Maeng & Nedovic-Budic, 2007). Most of these studies indicate that it is challenging to recognize the impact of complex and diverse changes in urban space and land use generated by ICT development due to the ambiguous linkages. Meanwhile, comprehensive studies have also pointed out that various aspects of urban development that are directly affected by ICT development include urban transportation systems, industry and economy, science and technology, and information systems (Cohen-Blankshtain & Rotem-Mindali, 2016; Eggleston, Jensen, & Zeckhauser, 2002; Maeng & Nedovic-Budic, 2010). These aspects have also been identified as important factors driving urban land growth in traditional land use driving force studies (Braimoh & Onishi, 2007; Parcerisas et al., 2012; Serra, Pons, & Saurí, 2008). However, with the emergence of the information era, the traditional factors driving urban land use changes have also been largely affected. Therefore, in order to help urban planners and policy-makers better implement urban "smart" development strategies, it is necessary to study and identify those land use drivers affected by ICT and their potential impact on urban land growth.

To fill the knowledge gap, we need to understand how local use and management of ICT take place across different levels of implementation including local, regional, and national strategies (Firmino, 2005). This article quantitatively analyzes the driving role of various smart city factors in urban development and explores the relationship between such factors and urban land use changes, in order to provide new insight relevant for future land development and urban planning. Since research on smart cities involves multiple socioeconomic aspects which are tightly connected, there is no uniform unit quantification standard for the various driving factors of land use changes. Besides, the construction of a smart city is led by the local government and the nature of every smart city is unique and highly context-dependent. Consequently, this article begins with the development strategy analysis of a case study city—Nanjing. Together with similar studies in the past, this article attempts to qualitatively identify the driving factors of smart city development with influential characteristics.

Due to the limitation of the publicly available data, it is almost impossible to fully take all driving factors into ac-

count. This article therefore uses the grey relational analysis (GRA) method to reduce the correlation error caused by the limitation in sample size and the uncertainty in the trend. Compared with the commonly used mathematical statistics methods, such as the analysis of variance, regression analysis, and main component analysis, the GRA method has advantages in generating consistent results of quantitative and qualitative phenomena. It is also widely applicable to small and irregular samples, using relatively simple calculations to reveal the dynamic characteristics of ICT-driven development (Kuo, Yang, & Huang, 2008).

The overall goal of this study is to discover what the ICT-led driving factors of urban land use change are in the context of smart city development in the studied city of Nanjing. Additionally, the purpose is to learn how these are associated with Nanjing's urban built-up land expansion. The specific objectives are to:

- Analyze the driving factors and driving mechanisms of urban land use change, applied to Nanjing;
- Explore the ICT-led "smart" driving factors of urban land use change using city development indicators applied to Nanjing;
- Implement the GRA method to analyze how "smart" driving factors correlate with urban land use change, applied to the city of Nanjing.

This article is organized into five sections. Section 2 studies the primary driving mechanism of urban land use change, applied to the city of Nanjing. Section 3 implements a quantitative correlation analysis on "smart" land use change drivers. Section 4 presents an empirical analysis followed by discussions on the data processing results. Section 5 summarizes the main findings and future research directions.

2. Study Area and Driving Factors

2.1. Study Area

Nanjing is a Chinese city with rich historical and cultural heritage, natural landscape and environmental resources, and modern landmark buildings. The city has long been an economic, political, cultural, education, and transportation center of southern China. Today, Nanjing is the capital of one of the wealthiest provinces of China, Jiangsu. As shown in Figure 1, Nanjing is located along the lower reaches of the Yangtze River in the southwest area of Jiangsu province. Today's Nanjing still adheres to the strategy of an open and innovative city-region. In 2006, Nanjing responded to the first call of the state in the new era and proposed a smart Nanjing strategy, "Build Smart City, Guide Future Development," which intended to dig deep into the advantages of urban resources endowment. Shortly after this, in 2008, the local govern-

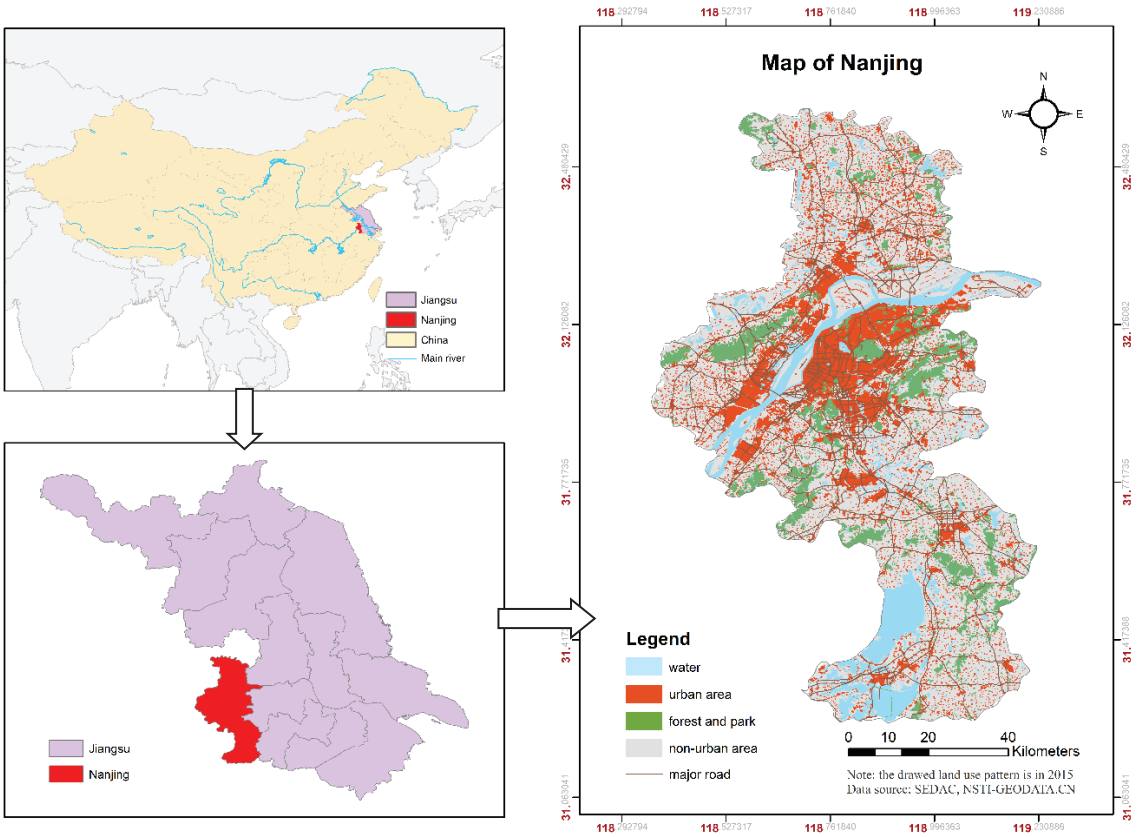

Figure 1. Map of Nanjing. Source: Authors.

ment included all the significant planning details of the smart city construction strategy into their 12th five-year urban development plan (Hu, Yan, & Wang, 2010). In the following years, due to the ongoing development of ICT, the internet of things, cloud computing, and other new technologies, Nanjing accelerated the construction of the smart city in the direction of the information industry, aiming to improve the level of social information and living standards of citizens. In 2013, Nanjing launched 46 smart city projects with a raised investment of 30.3 billion CNY (Tan-Mullins, Cheshmehzangi, Chien, & Xie, 2017). Most of these projects utilized ICT to improve citizens' social engagement with the city administrators, enhance public transportation, create enterprise opportunities, secure public safety, and sustain urban development. Designated as the pioneer of the smart city in China, smart Nanjing has made breakthroughs in areas including organizational establishment, data openness, civil service upgrade, and institutional innovation. The determination of the city in the strategic planning for the development of a smart city has made it a reality for the huge amount of capital investment in accelerating digitalization and urbanization. At the same time, the population is surging and the city is expanding significantly; all these characteristics make Nanjing an interesting case for this study.

2.2. Driving Factors

Urban land use changes take place under the joint influence of physical geographical factors and socioeconomic factors (Wang & Zhang, 2001). However, due to the different local characteristics and policies of different cities, its impacts vary greatly from place to place (Lambin et al., 2001). Thus, it is necessary to comprehensively analyze the complex factors such as the current development characteristics and policy status quo of the city. First, from the perspective of physical geographical factors, urban land use changes are usually restricted by local topography, soil, climate, biology, and so on. However, Nanjing is a city with rich natural resources, fertile soil, mild climate, and adequate water resources, all of which provide superior natural conditions for people to transform land use types with few restrictions (Platt, 2004). Such kinds of factors usually have minimal impact on urban land use changes in non-long-term studies. Besides, most studies have confirmed that socioeconomic factors are the most important driving force for the constant change of urban land use (Han, Hayashi, Cao, & Imura, 2009; Li, Zhou, & Ouyang, 2013). These factors usually include population, transportation, culture, industry, economy, technology, infrastructure, and more.

Because of the diversity and abstract evolution of socioeconomic factors under digitalization, the extended construction factors of smart cities have complex and profound effects on urban land use change. From the perspective of the driving mechanism, the construction of the smart city in Nanjing has a driving influence on the primary form of urban land use layout and the distribution of urban functional areas. Figure 2 shows a conceptual model that indicates the occurrence and effect of urban land use change driving mechanisms, as applied to Nanjing. Due to the different local conditions and goals of smart city development in different regions, the impact on urban land use change is also disparate. Therefore, this concept-driven model is only applicable to the specific city studied here.

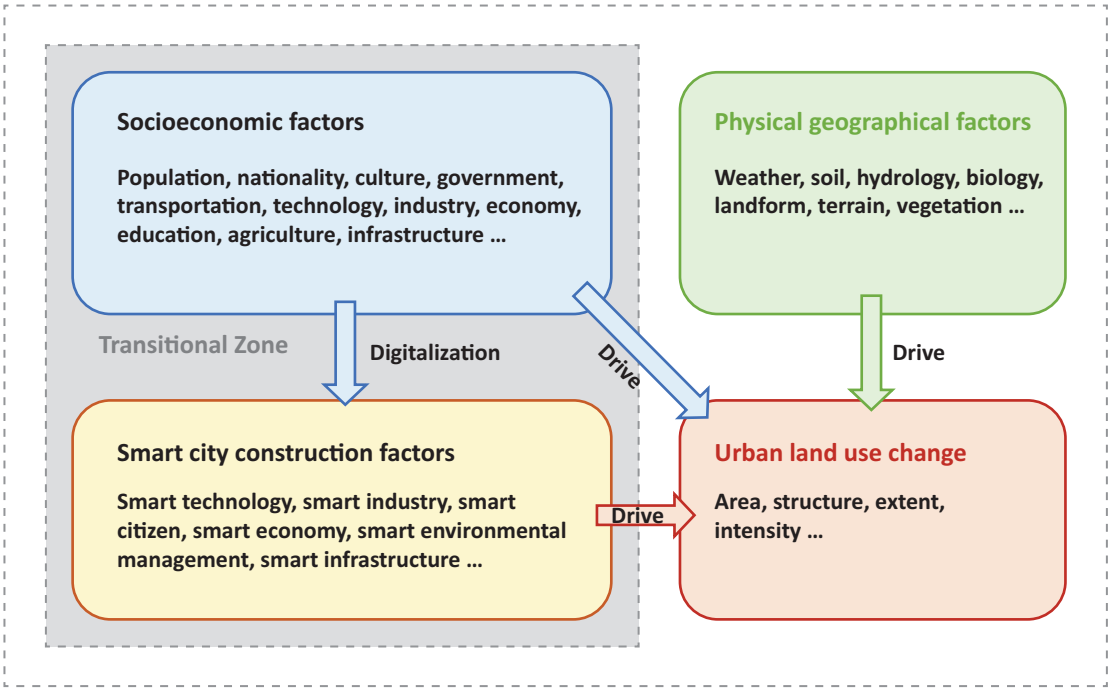

Figure 2. Conceptual model of urban land use change driving mechanism in Nanjing.

3. Quantitative Analysis of "Smart" Driving Forces

3.1. What Are the "Smart" Driving Forces?

The driving factors of a smart city are closely related to its development indicators, and some valuable information can be found in the relevant literature. Lea (2017) divides the factors influencing the development of smart cities into three categories: the technology aspects (i.e., the progress of technology itself), human aspects (such as lifestyle, education, and social aspects), and institutional aspects (such as urban planning and governance). All of these aspects are thoroughly interlinked and influence each other, and together they influence how the progression of technology affects the development of the urban environment. The progression of technology influences both how people behave within the urban environment and the possibilities for development using smart technologies. These influences, when parsed through the planning and governance institutions, eventually determine how the smart city will develop. Lombardi, Giordano, Farouh, and Yousef (2012) refer to the triple-helix of technological and smart city development as universities, government, and industry. These three parties, together with civil society, determine how technology will develop and influence the development of smart cities. In evaluating their influences on the city and the smart city's performance, they divide the aspects defining smart cities into five clusters, namely smart governance, smart economy, smart human capital, smart living, and smart environment.

Similarly, Giffinger, Fertner, Kramar, and Meijers (2007) create a smart city assessment approach for European smart cities, which evaluates the smart city system according to six indicators: smart economy, smart transportation, smart environment, smart residents, smart life, and smart management. There are many commonalities among these assessment methodologies for smart cities. For example, the evaluation system of smart city development is mainly based on the primary evaluation indicator of social and economic development. Therefore, we need to take into account some similarities between the main direction of the regional smart city development strategy and the evaluation system of the smart city in other studies. Based on the formulation and revision of Nanjing's smart city development strategy over the years, as well as the accessibility of the most relevant data, this study finally selects the following smart city development indicators as shown in Table 1. It can be noted the characteristics of the primary indicators are that they are all driving factors of land use change led by socioeconomic factors as discussed in Section 2.2. However, the focus of this study is still the indicator with the main representative characteristics of these aspects after being affected by ICT development. Thus, we have added sub-indicators to the five primary

Table 1. Nanjing smart city development indicators.

Primary indicator	Secondary indicator	Secondary indicator variable (units)
Smart industry and economy	Economic strength	X1: GDP per capita (CNY)
	Industrial structure	X2: The fixed social assets investment amount of the tertiary industry (1,000,000 CNY)
	Smart industry profitability	X3: Added value of tertiary industry (1,000,000 CNY)
Smart transportation	Urban space layout	X4: The area of roads (hectare)
	Public transportation resources	X5: The actual number of buses in operation at the end of the year (units)
	New means of public transportation	X6: The number of rail transit vehicles in operation at the end of the year (units)
Smart humanities and science	Education expenditure	X7: Education expenditure per capita (CNY)
	Population structure and quality	X8: The proportion of the population with higher education over the age of 25 (%)
	Human resources	X9: The proportion of employees in the ICT industry in the whole society (%)
Smart ICT system	Telephone communication environment	X10: Number of mobile phone users (10,000)
	Urban hardware facilities	X11: Number of inhouse fiber optic networks (10,000)
	Logistics system	X12: Quantity of express delivery (10,000)
Smart environment management	Waste handling capacity	X13: Treatment rate of domestic sewage (%)
	Urban green environment	X14: Green coverage in built-up areas (%)
	Urban ecological service	X15: The area of parks (hectare)

Note: Units of some selected variables have been adjusted to ensure unit consistency and ease of calculation.

indicators after the "smart" upgrade, making them different from the traditional land use driver indicators. Under each primary indicator except the smart ICT system, not only a representative traditional indicator (refer to X1, X4, X7, X14, and X15) will be considered, but also at least one "smart" secondary indicator will be included. Such diversified indicators will be included in the system to ensure that the final comparison result may produce more valuable information.

3.2. Data Collection

This study used the annual statistics of Nanjing from both the Statistical Yearbook of Nanjing and the Statistical Yearbook on Urban and Rural Construction. Based on the timing of Nanjing smart city construction and the availability of data, this study selected the corresponding variables of Nanjing smart city construction indicators from 2008 to 2018 as the research data, as shown in Table 1 in Supplementary File 1. In addition, we use the proportion of built-up area to urban area as the reference data, as shown in Table 2 in Supplementary File 1.

3.3. GRA

3.3.1. Theory

GRA was developed by Deng (1982) and has been applied in various research fields in recent years. The theory of GRA is to use certain mathematical calculations to measure the degree of association between variables according to the similarity and difference of the dynamic development changes among these variables based on cybernetics, information theory, and so on, so as to reveal the characteristics of dynamic association across different objects (Deng, 1989). As a multi-factor statistical analysis method, its largest advantage in the study of the drivers of urban land use change is the "grey" relationship system build-up while the interaction strength is unknown between the main factors and reference factors (Yang et al., 2008). This is in line with the research status of "smart" driving factors with unclear causal relationships and incomplete coverage. According to cybernetic conventions, the color from white to black represents the amount of known system information, and the grey is between the two—representing that we only have limited understanding of the internal structure of the system. Similarly, the value of the calculated grey relational coefficient from low to high (value range from 0 to 1) also means that the correlation between measurement factors and reference factors varies from low to high.

3.3.2. Data Normalization Processing

The core theory of grey correlation degree is to calculate the degree of relation between different variables. However, because there are different measurement units among statistical data, there are differences in dimensions and quantities. Different dimensions and orders of magnitude are difficult for comparison and analysis, which may lead to outcome errors and wrong conclusions. Therefore, dimensionless processing is required in this step for the original data. Typically, the general dimensionless processing mode used "0–1 normalization," as:

$$y_{ij} = \frac{x_{ij} - \min(x_{ij})}{\max(x_{ij}) - \min(x_{ij})} \quad (1)$$

Here, y_{ij} is the normalized data of the original data x_{ij}; i and j indicate the i'th indicator variable and the year of j in the collected research data. The results of normalization processing are shown in Table 1 in Supplementary File 2.

3.3.3. Grey Correlation Coefficient Modeling

In this section, we code in R and use RStudio software to transform and modeling the research data. R is an open-source programming language that provides complete support for data statistical processing and research while R Studio is the support system for R with an integrated development environment (Campbell, 2019).

Suppose the reference sequence after normalization is:

$$\{y_0(t)\} = \{y_{01}, y_{02}, y_{03}, \cdots, y_{0t}\} \quad (2)$$

The sequences that are compared in correlation with the reference sequence are:

$$\{y_1(t), y_2(t), \cdots, y_p(t)\} = \begin{Bmatrix} y_{11} & y_{12} & \cdots & y_{1n} \\ y_{21} & y_{22} & \cdots & y_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ y_{p1} & y_{p2} & \cdots & y_{pm} \end{Bmatrix} \quad (3)$$

Here, n represents the data length of the sequence. If we calculate the difference of kth ($k = [1, 2, 3,\ldots, p]$) value in the same period between the comparison sequence and the reference sequence, the absolute value of the difference is (while $t = 1, 2, 3,\ldots n.$):

$$\Delta_{0k}(t) = |y_0(t) y_k(t)| \quad (4)$$

Then we can retrieve the maximum and minimum values from the absolute difference series, which are denoted as (max) and (min) respectively. The (max) and (*min*) are further used for grey correlation coefficient calculation:

$$\gamma_{0k}(t) = \frac{\Delta(\min) + \rho\Delta(\max)}{\Delta_{0k}(t) + \rho\Delta(\max)} \quad (5)$$

Here, ρ is the distinguishing coefficient, whose function is to weaken the influence of the distortion of correlation coefficient due to the large $\Delta(\max)$. Typically, ρ is assumed to be 0.5.

Since the general correlation degree between the comparison sequences and the reference sequences is calculated by n correlation coefficient, it is necessary to centralize the correlation information. Generally, the mean value of correlation degree of p comparison se-

quences and reference sequences in each period is used to quantitatively reflect the overall correlation as follows:

$$r_{0k} = \frac{1}{n}\sum_{i=1}^{n}\gamma_{0k}(t) \quad (6)$$

4. Results and Discussions

The detailed calculation results of the grey correlation coefficient modeling are shown in Table 2 in Supplementary File 2. A higher grey correlation degree means a stronger correlation between the comparison sequence and the reference sequence. For an empirical view, when the distinguishing coefficient is set to 0.5, a correlation degree greater than 0.6 indicates a high correlation (Deng, 1989). As can be seen from the summarized results of grey correlation degree as shown in Table 2, the distribution of the correlation degree value of each "smart" driving factor is spread between 0.598 and 0.956. It indicates that Nanjing's "smart" drivers do have a correlation with local urban land use change, and it is probable that they drive urban land expansion to various extents.

The results of the correlation degree of the primary indicator of smart city development are summarized in Figure 3, which shows its distribution is from 0.721 to 0.922. It shows that all primary indicators have varying correlations with urban land expansion; the specific analysis for the indicators follows.

It can be seen from the primary indicators that the correlation between smart industry and economy and the change of urban land utilization ratio is the highest of all (0.922). Furthermore, the correlation values of all the three secondary indicators are above 0.9, indicating that smart industrial and economic development has a significant impact on the change of urban land use in Nanjing. Per capita GDP, which is not only a factor that drives the change of urban land use in the traditional sense but also a basic indicator measuring the economic development of a smart city, can reflect a city's economic strength, as well as its transformation and innovation capabilities. Since the implementation of the informatization strategy in Nanjing, the dynamic effect brought about by innovative industrial transformation has greatly promoted the demand for urban land. For example, the development of new districts and the reconstruction of shanty towns have both directly affected the development extent and intensity of urban land use in Nanjing. The growth of the tertiary industry in terms of investment and added value year-by-year reveals the improvement and evolution of the urban industrial structure from traditional manufacturing to circulation and service industries. Meanwhile, as the informatization process speeds up, the tertiary industry has also had a technological transformation and begun to add more value, resulting in the expansion and transformation of urban land use in a manner which is both more intensive and efficient.

The grey correlation of smart transportation is also 0.922, which ties with the indicator of smart industrial economy as the factor with the highest correlation, suggesting that the development of transportation is another factor closely related to the change of urban land use in Nanjing. Specifically, the increase of total road area shows that the urban spatial scale has become less constrained by the time scale, which to some extent reflects

Table 2. Grey correlation degree results for "smart" driving factors.

Primary indicator	R degree	Secondary indicator variable	R degree
Smart industry and economy	0.922	X1: GDP per capita	0.948
		X2: The fixed social assets investment amount of the tertiary industry	0.912
		X3: Added value of tertiary industry	0.907
Smart transportation	0.922	X4: The area of roads	0.956
		X5: The actual number of buses in operation at the end of the year	0.914
		X6: The number of rail transit vehicles in operation at the end of the year	0.896
Smart humanities and science	0.898	X7: Education expenditure per capita	0.899
		X8: The proportion of the population with higher education over the age of 25	0.923
		X9: The proportion of employees in the ICT industry in the whole society	0.870
Smart ICT system	0.803	X10: Number of mobile phone users	0.746
		X11: Number of inhouse fiber optic networks	0.862
		X12: Quantity of express delivery	0.803
Smart environment management	0.721	X13: Treatment rate of domestic sewage	0.772
		X14: Green coverage in built-up areas	0.598
		X15: The area of parks	0.791

Note: The distinguishing coefficient is valued to 0.5.

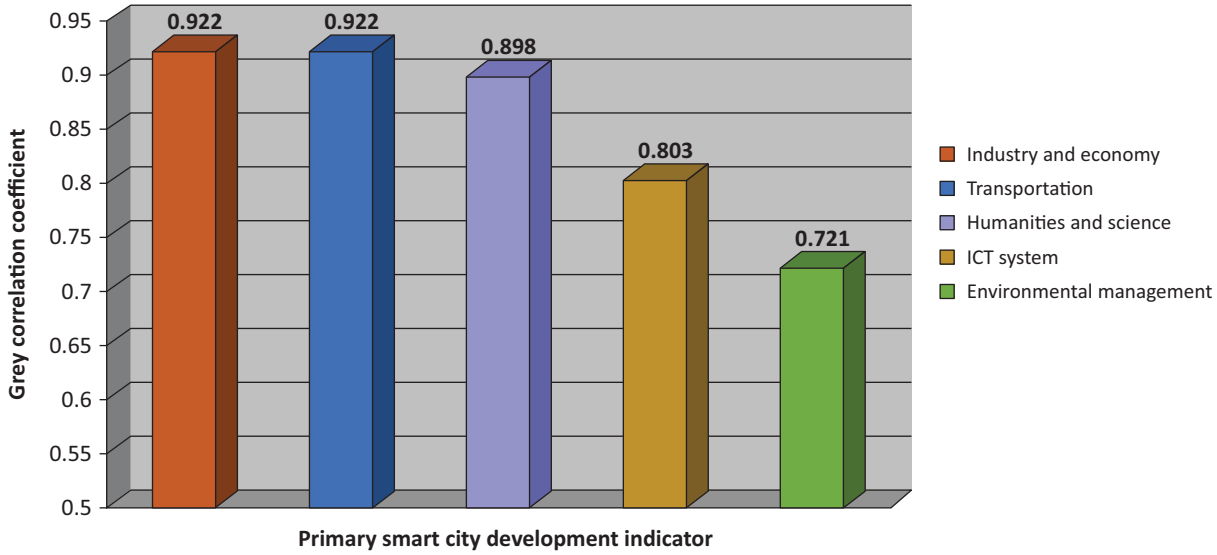

Figure 3. Grey correlation degree of primary indicators of smart city development.

a scientific development of urban transportation space. Throughout the past decade, the expansion and renovation of urban roads has been ongoing in Nanjing; as a direct consequence, the total urban road area has been growing rapidly and consistently. On the other hand, the rapid growth of bus and rail transit services also mirrors the improvement of the utilization of urban road resources alongside the establishment of the urban smart transportation system. This has greatly accelerated the internal population mobility and mitigated road congestion within the urban area, and indirectly improved the extent of urban land use, laying a solid foundation for a benign expansion of urban land.

For the indicator smart humanities and science, the correlation is 0.898, ranking third of the primary indicators. More specifically, the correlation value between the proportion of highly educated people and the change of urban land use is as high as 0.923, suggesting that highly educated residents can produce a higher value for urban construction and development. The indicator of per capita education expenditure, as an important symbol of educated population, implies the level of educational consumption in the target area and reflects the public's degree of acceptance, perception, acquisition, and application of scientific knowledge. However, the correlation of this indicator is lower than that of the proportion of highly educated people, which is probably because the education system has a long output circle and its direct contribution to the social value is limited in the short term. But in the long term, the continuous growth of per capita education expenditure is conducive to the cultivation of an educated population. The indicator of people engaged in ICT services demonstrates the human resources status of the information industry to a certain extent, and indirectly reflects the development of urban information technology. The improvement in the productivity and attractiveness of urban land will consequently promote the change in urban land utilization.

The correlation between smart ICT system and urban expansion is 0.803, lower than the indicators mentioned above, but it also drives urban expansion to some degree. Among its secondary indicators, the number of Internet access users represents the level of urban Internet construction, which is a key and typical indicator for the construction of smart infrastructure and therefore has the highest correlation with urban expansion (0.862). This indicator reflects the popularity and digitalization of the urban network, not only accelerating the flow of effective urban information but also increasing the attraction of a smart city to the people from its surrounding regions. Similarly, the increase in the number of express deliveries indicates the continuous expansion of the express industry, the improvement of urban logistics system, the enhancement of livelihood service ability, and the increase of information intelligence. However, with the effect of the traditional business model transforming from offline to online under the impact of information technology, the development of the tertiary industry has experienced an exponential growth in recent years, and thus, its synergic development with urban land expansion has been highly affected. The number of mobile phone users reflects the popularity of urban communication facilities; as an interactive carrier of information space, communication facilities have become the hardware infrastructure for people to directly access to smart city services and management. But because mobile phones had been popularized in Nanjing as early as in 2008, the growth of mobile phone users in recent years may only imply the increase in urban population. Moreover, in view of the common phenomenon that one user may have multiple phones and numbers, the actual reference value of this indicator is much reduced (only 0.746).

The correlation between smart environment management and urban expansion is the lowest out of the primary indicators (0.721). Specifically, both the area of parks and the green coverage rate of the built-up re-

gion can reflect the environmental attractiveness of a city and the quality of urban living environment, but the correlation value differs greatly between the two (0.791 and 0.598 respectively). The construction of green infrastructure is often started after the completion of the municipal grey infrastructure, which means it usually occurs after the corresponding urban land expansion phenomenon, and therefore exhibits a delay and an insignificant driving effect. On the contrary, the area of park is more consistent with the trend of urban land expansion, suggesting that people's demand for green ecological services is on the rise together with the development of the city. Finally, the correlation between the urban sewage treatment rate and urban land expansion is 0.791. Although this indicator shows an overall increasing trend year by year, due to the bottleneck encountered after the renovation of scientific and technological means or services, the sewage treatment rate has been gradually approaching to 100% and its relevance with urban expansion may decline in the future.

To sum up, we observed that there is a strong correlation between many of the chosen "smart" city development indicators and urban growth in Nanjing, particularly the indicators in the industry and economy, transportation, and humanities and science categories. Although these primary indicators are traditional land expansion drivers, we observe that the secondary "smart" indicators affected by ICT are still close to the grey correlation value found for the traditional indicators. This further confirms that the traditional urban land use change factors affected by ICT, even if defined as "smart" drivers, still have an influence on urban land expansion.

5. Conclusion

This study investigates the impact of ICT expansion on urban growth by means of the GRA method. The case study of Nanjing's smart city development has elucidated the ICT influence on regional economic, political, cultural, social, and evolving urban spatial structure. We believe that this research approach used from the qualitative analysis of traditional land use driving factors to the quantitative exploration or grey scale correlation, can be applied to other cities as well. Based on our analysis, we summarize the following main points:

- GRA is an effective and convenient method, especially in view of ambiguous definitions of indicators, difficulty in data collection and lack of relevant information. Although GRA is a traditional data analysis method, to our best knowledge it here used for the first time to quantify the correlation between driving forces and land expansion;
- From the significant changes in various indicators, it is apparent that the smart city construction in Nanjing has happened at a rapid rate from 2008 to 2018. The relatively high correlation between the smart city development indicators and urban land expansion further show that most of the smart city construction strategies in Nanjing have more or less driven urban land expansion. Therefore, it is suggested that the top layer design of urban land planning needs to be better optimized with respect to various indicators to achieve a more efficient use of resources;
- Prioritizing the industrial economy and transportation has been a win-win approach for simultaneously achieving urbanization and "smartness" in the city of Nanjing. However, indicators with a weaker effect on urban expansion, such as humanities and science, information system, and environmental management should also be accounted for, as they have all played essential roles in improving urban land utilization and enhancing people's quality of life.

In general, urban planners and decision-makers should understand the priorities of smart city development indicators at all stages of urban development, so as to properly adjust and respond to urban land expansion and help better coordinate land use planning in the future. Urban growth is a complex process involving the interaction of many factors, therefore there is no single model that can prove its direct driving causality, especially in view of the limited information that is generally available. The GRA method considers the changes in multiple variables and establishes a grey correlation among the "smart" driving factors and urban built-up land area, however correlation does not imply a simple causal relationship that explains the driving effect.

More research should therefore focus on causality. To this end, we first need to explore more effective "smart" drivers as comprehensively as is possible with the available data. Furthermore, we need to explore the future development of cities from different perspectives and on different scales, by including more land use indicators in the reference sequence, such as the urban land use degree and intensity. Finally, we can combine the "smart" drivers with the traditional urban land use change drivers to jointly establish optimized regression models for monitoring and simulating future land use change.

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Conflict of Interests

The authors declare no conflict of interests.

Supplementary Material

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

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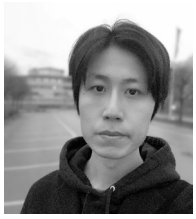
About the Authors



Zipan Cai is a PhD student in the Department of Sustainable Development, Environmental Science and Engineering (SEED) at the KTH Royal Institute of Technology, Sweden. His research interests include urban spatial planning, spatial dynamic modeling, planning support system, and smart city studies. He has over 9 years of experience in the field of GIS and related professional skills. His current research focuses on decision support for urban planning.

Vladimir Cvetkovic (PhD) is a Full Professor in water system engineering at the Department of Sustainable Development, Environmental Science and Engineering (SEED) at the KTH Royal Institute of Technology, Sweden. His research has been mostly focused on water resources involving theoretical and experimental studies. Since 2015, he has been coordinating and working on projects related to urban systems in particular the socio-technical development toward sustainable smart cities.

Jessica Page is a PhD student at Department of Physical Geography, Stockholm University, Sweden. Her focus is on urban and regional planning, in particular on using technology and planning support systems to further sustainability goals in cities through the study and modelling of the interactions between urban and sub-urban social systems with various ecological systems, ecosystem services and water-climate interactions.

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