From the accidental to articulated smart city: The creation and work of 'Smart Dublin'

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Abstract

While there is a relatively extensive literature concerning the nature of smart cities in general, the roles of corporate actors in their production, and the development and deployment of specific smart city technologies, to date there have been relatively few studies that have examined the situated practices as to how the smart city as a whole unfolds in specific places. In this paper, we chart the smart city ecosystem in Dublin, Ireland, and examine how the four city authorities have actively collaborated to progressively frame and mobilise an articulated vision of Dublin as a smart city. In particular, we focus on the work of 'Smart Dublin', a shared unit established to coordinate, manage and promote Dublin's smart city initiatives. We argue that Smart Dublin has on the one hand sought to corral smart city initiatives within a common framework, and on the other has acted to boost the city-region's smart city activities, especially with respect to economic development. Our analysis highlights the value of undertaking a holistic mapping of a smart city in formation, and the role of political and administrative geographies and specialist smart city units in shaping that formation.

Key words: smart city, governance, Smart Dublin, test-bedding, procurement by challenge, SBIR, strategy, scaling

Introduction

A somewhat ambiguous term, 'smart city' is now at the vanguard of concepts concerning urban development, replacing and incorporating a series of precursors that included the wired city, the innovation city, digital city, the intelligent city, and the creative city (Hollands 2008; Kitchin 2014). The term denotes something inherently positive, for who can be for the 'dumb city'? It also suggests more than the embedding of digital technologies in urban infrastructures and their deployment to manage cities more effectively, hinting at the clever entwining and integration of systems used to govern cities, enabling the 'breaking down of silos', 'joined-up thinking' and 'data-driven, real-time control', thus creating efficiencies and improved services. Importantly, the notion of a smart city is not confined to the operations of local government, with individuals gaining access to smartness through a plethora of smartphone-delivered industry- or citizen-created apps and services that provide information and enable choice and decision-making on the move, and privately delivered services (such as smart metering and smart parking). Data from these individuals, and the technologies they interact with, can in turn feedback into the operation of the city through citizen-sensing and crowdsourced reporting (Gabrys 2014).

While there is a relatively extensive literature concerning, on the one hand, the nature of smart cities in general terms and the roles of specific actors such as IBM (e.g., Hollands 2008; Townsend 2013; McNeill 2015; Söderström et al., 2015), and on the other, the development and deployment of specific smart city technologies (e.g., urban operating systems, control rooms, smart grids, smart parking, smart waste management, sensor networks, smart lighting, etc.), to date there have been relatively few studies that have examined the situated practices as to how the smart city *as a whole* unfolds in specific places (Kitchin 2015). Initial studies include Ayona Datta's (2015) examination of the formation of Dholera City in India; Alan Wiig's (2016) study of Philadelphia's smart city initiatives; Michelle Cullen's (2016) examination of Portland, Oregon and Dubuque, Iowa; Federico Cugurullo's (2016) research about the development of Masdar, UAE; and a number of studies of Songdo, South Korea (Carvalho 2012; Kim 2014; Shin *et al*. 2015; Shwayri 2013). Interestingly, Dholera, Masdar and Songdo are all new, from-the-ground-up cities on greenfield sites. Moreover, both Wiig and Cullen's studies focus on the core role played by IBM in initiating smart city programmes. Studies focusing on the situated and contextual nature of smart city adoption in existing cities tend to focus on the rollout of specific

initiatives and technologies, rather than mapping out the panoply of smart city initiatives and how they work (or not) in concert.

In this paper, we provide a mapping at a city scale of the various smart city initiatives underway, how they are managed and governed, and how they are corralled within a smart city framework. Such a mapping is important for four reasons. First, it reveals the diverse initiatives that make up a smart city and the different configurations of ICT instrumentation and regulation devices, policies and economic development strategies, and governance and civic engagement practices. Second, it highlights how 'smart city interventions are always the outcomes of, and awkwardly integrated into, existing social and spatial constellations of urban governance and the built environment' (Shelton *et al.* 2015: 14). Despite the claims of multinational high-tech corporations that cities are a *tabula rasa* for innovation, smart city initiatives are layered onto or replace existing city systems and infrastructures, and fit within or rejig organisational structures and established modes of practice. Third, it exposes how the development of a smart city is far from stable and linear in nature, but rather unfolds through a set of contingent and relational processes shaped by local governance practices, political priorities, political economic context, and institutional settings. As such, the approach provides situated accounts of how smart cities emerge and are designed in practice. Fourth, it illustrates the role of new institutional bodies within and across local governments in organising and promoting the smart city agenda. Many cities have created new smart city units whose job it is to coordinate smart city initiatives across city departments and agencies, but to date the work of these units has been little documented.

Our empirical case is Dublin, Ireland, charting how Dublin has progressively framed and mobilised itself as a smart city. Our principle focus is 'Smart Dublin', the city-region's unit for coordinating, managing and promoting its smart city initiatives, and its formative phase in 2015-2016. In particular, we are interested in how Dublin evolved from what might be described, in Paul Dourish's (2016: 37) terms, as the 'accidental smart city' to an 'articulated smart city'. For Dourish, the:

> 'story of the accidentally smart city is not of one in which a single strategy and coherent design approach yields an urban space in which information is woven into the fabric. Instead, the city becomes smart … [in a] piecemeal, gradual, disparate manner … little by

little, one piece at a time, under the control of different groups, without a master plan, and with a lot of patching, hacking, jury-rigging and settling' (p. 37).

While the development of a smart city will always remain somewhat 'accidental', unfolding through a diverse set of initiatives driven by varying actors and stakeholders pursuing different interests, in the 'articulated smart city' existing initiatives are corralled into the semblance of an overarching, coordinated, strategic and branded narrative, into which future smart city initiatives are likewise folded. Smart Dublin is the vehicle for creating such an 'articulated smart city' in Dublin. It should be noted, however, that Dublin's path to becoming a smart city extends back much further than 2014. As we detail in a separate forthcoming paper, a clear path can be traced back from Smart Dublin to the innovation and creative city agenda of the 2000s, and to the entrepreneurial city agenda of the 1990s, in terms of the underpinning neoliberal ideology and some of the actors driving urban development in the city. While we are mindful of this longer trajectory, here we are more centrally interested in the period where the city self-declares itself 'smart' and the transition from an 'accidental' to 'articulated' smart city.

Our analysis is based on a detailed mapping of the smart city initiatives underway in Dublin in 2015 and a set of in-depth interviews and participant observation concerning the creation of Smart Dublin. The research started as a collaboration with Dublin City Council as a pre-cursor to the formation of Smart Dublin. The task was to conduct an audit of existing smart city-related initiatives in the four Dublin local authorities, to undertake interviews with those working on these initiatives to better understand their work, and to facilitate 'challenge' workshops in each of Dublin's four local authorities (LAs) to identify key issues that a smart city approach might address in the Dublin case. The challenge workshops were conducted in late 2015 and early 2016. Each workshop was opened by a presentation describing the regional scope of the initiative, the key concepts underpinning it, and the detailing the desire to identify existing smart city initiatives and 'challenges' which might be tackled to drive efficiencies and improve the lives of citizens. Participants then broke into groups of five to seven, with members from different background and competencies from across the organisation, and conducted two 40 minute sessions of group discussion and debate, moderated by a facilitator. The group discussions were structured around a fairly standard classification of smart city technologies developed by Giffinger and Pichler-Milanović (2007) and adopted by a number of bodies

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including the European Union and IEEE (see Table 1). The first session of each workshop sought to delineate understandings of what was meant by 'smart' from the participants, and then to collect examples of smart projects in their local authority based on the classification. During the second session, participants suggested and discussed new challenges. After the workshops, reports with feedback were prepared, followed by further stakeholder engagement to refine priority challenge areas and develop problem statements.

Following the workshops, we conducted 25 in-depth interviews with a selection of projects identified in the audit[1]. The initiatives selected were those that were already mainstreamed and used to deliver city services, and excluded pilot or terminated projects, or initiatives that were deemed extremely narrow in scale or serving a very limited audience. A further set of seven interviews were conducted for the launch of Smart Dublin to help write case studies for the Smart Dublin website and promotional material. Interviews typically lasted around an hour and were structured around a series of basic questions. They often also included a site visit to view the technologies in operation. Interviewees were drawn from a range of sectors (4 academics, 17 LA workers, 5 state agency managers, 5 industry workers, 1 civil society worker). Further, one of the authors has also been an external member of the Smart Dublin steering group that has met monthly. In addition, the study had access to 42 other interviews conducted with smart city stakeholders in Dublin conducted between February and May 2015 as part of a sister project undertaken by one of the authors[2].

The Dublin region and the 'accidental smart city'

While the Greater Dublin Area covers the counties of Meath, Kildare, and Wicklow, the principle core urbanised area is administered by four LAs, covering an area of 920.66 km^2, with a population of 1,345,402 (Census 2016). These include Dublin City Council (DCC) at its centre, Dún Laoghaire Rathdown (DLRCC) and South Dublin (SDCC) County Councils to the south and west, and Fingal County Council (FCC) to the north. Each LA is independent and autonomous, with its own CEO, service departments, and elected officials. There is no city-wide mayor or overarching governance body that coordinates and oversees the four LAs. The Dublin Regional Authority had limited powers and was dissolved in 2014 and its replacement, the

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[1] Labelled SDx in the subsequently quoted interviews
[2] Labelled DSCx in the subsequently quoted interviews

Eastern and Midland Regional Assembly, overarches 12 local authorities and similarly has no executive function with respect to the day-to-day operation of the four Dublin LAs. The LAs mandate is restricted compared to other jurisdictions, covering planning, housing, waste, roads and traffic, parks and recreation, and local enterprise, but not health, education, social services or public transit, which are delivered through other agencies. While the four Dublin local authorities have open channels of communication, collaboration between them is rather limited, each focusing on the delivery of services within their respective areas.

This fragmented governance structure has meant that up until 2014, smart city initiatives have largely been pursued individually by each LA. Table 1 details 28 different, mainstreamed, operational smart city technologies used by the LAs to manage city services, classified using the Giffinger and Pichler-Milanović (2007) typology of smart city initiatives, although it should be noted that there is some overlap between categories.[3] As the descriptions make clear, the systems are broad in scope and seek to address a diverse range of issues. In Table 2 we highlight further the similarities and differences between the systems, noting whether they utilise sensor technologies, the extent to which they are automated, their generation/use of open data and data analytics, the means by which they are citizen engaged and the channels they employ, and the form of procurement adopted. Several of the projects incorporate networked sensors, forming part of the Internet of Things (IoT). These are more likely to involve forms of algorithmic decision-making, with varying degrees of human oversight and involvement. Being 'in the loop' refers to systems which identify and select profiles and targets, but which do not result in actions until a human manually approves; 'on the loop' is a system able to create actions based on its own analytic functions, but there is an operator in an oversight role that can intervene; and 'out of the loop' is a fully automated system that acts without human input (Citron and Pasquale 2014; Kitchin 2016). Examples include Dublin's traffic control system, SCATS, (Sydney Coordinated Adaptive Traffic System) – an intelligent transport system – which utilises inductive loops installed under the surface of road junctions to send data about traffic flow into a central system that then automatically alters the preconfigured traffic light timings to minimize congestion. The smart bins compact rubbish and then report back to a central system in order to

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[3] We identified over 50 different smart city initiatives, but many were institutional or support-orientated (e.g., accelerator programs for tech start-ups working on smart city solutions) rather than technical systems or were pilot or research initiatives.

schedule an efficient, minimal distance, collection route. In other cases, asset management systems, such as fleet monitoring and work scheduling in SDCC, make use of simple algorithms to minimise journey times and redirect workers in the field to problems in their area. Such semi-automated systems are relatively commonplace, with SCATS facilitating automated call-outs to engineers to investigate and repair faults in situ. The LEAP transport card, introduced relatively late compared to peer cities, calculates fares for multi-modal journeys.[4] These activities are merely the latest in a series of innovations rolled out in both the public and private sectors, notable in some cases because they have been made more visible, such as the case with Real-time Passenger Information (RTPI) displayed at bus stops. Public bodies and civic communities are more likely to take a leading role in web-based, mobile-platform-based, and open data initiatives, such as Dublinked and the Dublin Dashboard. In other cases, public bodies could be said to be merely furthering the well-established path to e-governance, such as is the case with the switch to a Customer Relationship Management (CRM) system in SDCC. This is largely standard practice, albeit here with the integration into service delivery systems, such as grass cutting route-mapping and public maintenance scheduling.

The technologies detailed in Tables 1 and 2 are largely proprietary and use varying hardware, software, standards, and data formats that can make them incompatible with other systems. The initiatives were initiated at different times. For example, although operational since 1987, the traffic control room has undergone several iterations, with SCATS installed in 1989 and continually evolving over the past two decades (McCann 2014). Later projects, such as the community hackathons and open data portals, are more tied to recent turns more globally to civic hacking and open knowledge sharing. Moreover, the systems work across different spatial scales – buildings, within LAs, across LAs, city-wide, nationally – due to institutional remits and multiple organisational practices. With respect to the national scale, in a relatively small European State (population 4.6 million), with no other city-region comparable in size to Dublin within its borders, the national scale represents a more efficient investment for technologies such as pavement management systems (Map Road PMS), travel smartcards, and real-time passenger information systems across major providers. In addition, the initiatives are fragmented not only across LAs, but also across departments within those authorities. We interviewed a number of

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[4] The data from LEAP card users themselves is currently not available and was kept confidential, partly to forestall any concerns from the public that might impact on the adoption of the smart travel card (interview, SPD27).

staff who did not know of other smart city systems in their own organisation. In other words, the systems we document were independently conceived and operated, procured or built to perform a particular task but outside of any wider smart city strategy.

As Paul Dourish (2016) argues, drawing on the work of Edwards and Grinter (2001) on the challenges of implementing ubiquitous computing more generally, Dublin had developed as 'accidentally smart', accreting slowly over time without much design intent, rather than being smart by design. Indeed, it should also be noted that many of systems detailed in Tables 1 and 2 were not initiated or funded under the rubric of smart cities and when we interviewed their staff they did not consider themselves to be part of a smart city endeavour, but rather working in IT, transport, waste management, etc. The four LAs, and the city more broadly, have acquired digital capacities slowly and accumulatively, with the various elements not designed to be part of a wider whole. Such accretion produces a certain path dependency and legacy systems that are not straightforward to append or replace.

The consequence of this fragmentation and diversity was that until 2015, Dublin, while deploying a number of smart city technologies, was not widely thought of as a smart city within Dublin or elsewhere (not appearing at the top of international rankings). This was made clear in the set of 42 interviews with stakeholders who were overwhelming in their view that Dublin was not a leader in becoming a smart city. For example:

> 'Well, I suppose I can think of plenty of cities that have done less and I can think of plenty of cities that have done more. I don't think I would say we are in the upper third to be honest … I think there aren't that many things you could say on the streets of Dublin that you'd be credible saying, 'we are a leader in smart cities'.' (DSC24, director, state agency)

> 'I wouldn't say Dublin is a smart city at all. I would say it wants to be perceived as a smart city and it is keen to be an early follower but it is not a leader in any way shape or form.' (DSC9, manager, civic organisation)

Interviewees noted that the smart city landscape was highly fragmented. For example:

'I don't know where the problem is: is it that everything is fragmented, that there are different city councils, different authorities that have to be consulted and different boards? If you look, you have DCC, you have Fingal, Dún Laoghaire Rathdown, you have got all of these different councils, are they all trying to do different things or are they all in agreement or what happens? My personal feeling is that it is a little bit fragmented, what goes on in the city. And even from what I am seeing is that there is all these different groups doing really cool projects, but we are not all sitting down together seeing which are the best ones, which are really applicable now, which can we go with now? I used to think it was just bureaucracy but I think actually that it is fragmented.' [SD3, project coordinator, university]

Collectively, interviewees identified a wide-range of issues that they felt was holding Dublin back from becoming a smart city, including:

- a piecemeal approach and a lack of a guiding strategy with associated mission and goals;
- an absence of joined-up thinking across LAs, their departments, and other stakeholders, and a preponderance of siloed-systems;
- weak governance structures and an absence of directed leadership;
- a lack of a formalised process of engagement between LAs, stakeholders and others;
- under-resourcing of investment and weak staffing and skills capacity;
- an imbalance in the capacity and enthusiasm for LAs and a lack of cooperation between LAs to create sufficient scales of economy;
- inflexibility in the working practices and a staid cultural mindset in LAs with respect to procurement, experimentation, and operations; and
- too many political/regulatory barriers for implementation.

Nonetheless, the majority of interviewees also felt that the city was progressing and, moreover, that there were large opportunities to be gained from pursuing a smart city agenda. For example:

'I don't think there is a city that is unbelievably advanced in this game, I think it is a real emerging space. That is why I think it is such a big opportunity for the city to really grab this by the neck and go for it with the right leadership, the right governance, and the right partners the opportunity is huge. … We seem to be moving faster than I thought we would and I think there is exciting initiatives and projects that are emerging or are under way. I think a lot of people would be jealous of the companies we have based here and I think maybe we could harness that a bit better in terms of the opportunity and the research and the products that they are contemplating.' (DSC1, LA worker)

Aware of the perception that the city-region was not a leader in smart cities and that there were potential opportunities to becoming a smart city and a perceived leader, the four local authorities took the collective decision in 2015 to create a smart city unit, articulate a new vision for Dublin as a smart city, and brand the city as 'Smart Dublin'. In so doing, it sought to start a shift from Dublin as an 'accidental' to 'articulated' smart city.

Table 1: Selected smart city initiatives (28 in total) undertaken by or with local authorities in the Dublin city region

	Name	Year initiated	Scale	Description
Smart economy (entrepreneurship, innovation)	Dublinked	2013	City	Provides access to city datasets, including some real-time data feeds
Smart environment (green energy, sustainability, resilience)	Sonitus sound sensing	2007	Local Authorities	Network of sound sensors monitoring noise levels
	EPA pollution monitoring	2008	Nationwide	EPA network of pollution sensors
	Big Belly Bins	2010	Local Authorities	Networked compactor bins that use sensors to monitor levels; waste collection route optimisation
	CODEMA + DCC energy monitoring	2012	City	Real-time monitoring of energy use in local authority buildings; publicly displayed on screens
	Docklands 21	2015	Local Authority	Locality-based consortium seeking sustainability gains.

	Spatial Energy Demand Atlas (Codema)	2015	Local Authority	Energy use and district-heating feasibility mapping.
Smart government (e-gov, open data, transparency, accountability, evidence-informed decision making, better service delivery)	CRM workflow system	2004	Local Authority	Customer relations management system used to interface with the public and undertake workflow planning.
	Fleet Management	2010	Local Authority	GPS tracking of local authority fleets and route optimisation.
	Public realm operations map	2010	Local Authority	An interactive map that reports scheduled public works.
	Fix-your-street	2011	Nationwide	A website and app for reporting issues (e.g. vandalism, dumping, potholes) to local authorities.
	Map Road PMS	2011	Nationwide	National pavement management system for road maintenance.
	Lexicon Library	2014	Building	New build library with smart control systems and digital services.
Smart living (quality of life, safety, security, management of risk)	Map Alerter / Unfolding News	2010	Local Authorities	Real-time alerts for weather and flooding.
	Dublin Dashboard	2013	City	Comprehensive set of interactive graphs and maps of city data, including real-time data, as well location-based services.
	Smart Stadium	2015	Building	Sensor network monitoring different facets of stadium use.
Smart mobility (intelligent transport systems, multi-modal inter-op, efficiency)	Traffic Control Room	1987	Local Authority	A suite of different technologies including SCATS (transduction loops at junctions), CCTV, ANPR (automatic number plate recognition cameras), detection of breaking red lights at Luas (tram) lines, feeding into a centralised traffic control room.
	ANPR	2005	Local Authority	Automatic Number Plate Recognition for data analytics on traffic volumes, both local and passing through area.
	E-flow road tolling	2008	City	Automated roll tolling/billing using transponders.
	Dublin Bikes	2009	Local Authority	Public hire bike scheme.
	Leapcard	2011	Nationwide	Smart card access/payment for trains, buses and trams.
	RTPI	2011	Nationwide	Digital displays at bus and tram stops and train stations providing information on the arrival/departure time of services.
	Insight ICT	2013	Local Authority	Data analytics system with crowdsourcing, integrated into traffic system.
Smart people (creativity, inclusiveness, empowerment, participation)	TOG	2009	City	Civic hacking coding meetups.
	Fingal Open Data	2010	Local Authority	Local authority open data sets.
	CIVIQ / Citizenspace	2012	Local Authority	Web consultation for planning documents and other policy proposals.
	Code for Ireland	2013	Nationwide	Civic hacking coding meetups.

	Geohive	2015	Nationwide	Open spatial data website, facilitating customised maps.				

Table 2: The characteristics of the selected smart city initiatives in Dublin

Name	Sensor	Feedback loops			Data usage		citizen engagement	Procurement
		in	on	out	open data	data analytics		
ANPR	Y	.	.	.	.	x	.	Direct procurement
Big Belly Bins	Y	.	x	x	.	x	.	Direct procurement
CIVIQ / Citizenspace	.	.	.	.	x	.	web	Direct procurement
Code for Ireland	.	.	.	.	x	x	community	Civic voluntarism
CODEMA + DCC energy monitoring	Y	x	.	.	.	x	report	Directive-driven
CRM workflow system	.	x	x	.	.	x	Public service	Internal
Docklands 21	Y	.	.	.	.	.	radio / social media	Gov-ind collab
Dublin Bikes	Y	.	x	x	.	x	app / web / public service	Direct procurement
Dublin Dashboard	.	.	.	.	x	x	web / API	Gov-res collab
Dublinked	.	.	.	.	x	.	data portal	Gov-res collab
E-flow road tolling	Y	.	.	x	.	x	Web / public service	
EPA pollution monitoring	Y	x	.	.	x	x	.	Directive-driven
Fingal Open Data	.	.	.	.	x	.	web	Internal
Fix-your-street	.	x	.	.	x	x	web / app	Internal
Fleet Management	Y	x	x	.	.	x	.	Internal
Geohive	.	.	.	.	x	x	Web	Internal
Insight ICT	Y	x	.	.	.	x	.	Gov-res collab
Leapcard	Y	.	x	x	.	x	app / web / public service	Gov-ind collab
Lexicon Library	Y	x	x	x	.	x	.	Architectural
Map Alerter / Unfolding News	.	x	x	.	.	x	app	Direct procurement
Map Road PMS	.	.	x	.	.	x	.	Gov-ind collab
Public realm operations map	.	.	.	.	.	.	web	Internal
RTPI	Y	.	x	x	x	x	app / web / API	Gov-ind collab
Smart Stadium	Y	.	x	x	.	x	.	Gov-res-ind collab
Sonitus sound sensing	Y	x	.	.	x	x	web / API	Gov-res-ind collab
Spatial Energy Demand Atlas (Codema)	Y	.	.	.	.	x	radio / social media	Gov-NPC collab
TOG	.	.	.	.	x	x	community	Civic voluntarism

Traffic Control Room	Y	x	x	x	x	x	radio / social media	Gov-ind collab

Smart Dublin and the articulated smart city

Smart Dublin has its origins in the foundation of Dublinked, a shared open data repository. Dublinked was established in 2011 as a shared initiative of the four Dublin LAs. It was as initially framed as an economic innovation initiative (it would fuel an open data economy), and was co-owned by the four local authorities and Maynooth University, with IBM supplying the technology platform. Each LA transferred funding into a central pot to fund Dublinked's activities and core staffing. Dublinked is still an active collaborative project and given its focus and already existing institutional structure, governance and funding arrangements, it became the foundation base for establishing Smart Dublin, along with the smart city program manager role in DCC, which was created in 2013, reporting directly to the CEO. Prior to Smart Dublin's launch in March 2016, the Dublinked staff and its steering committee (which met once a month), along with DCC's smart city program manager, took on the role of establishing the new initiative. After the launch, Dublinked, while maintaining its own branding, was subsumed into the Smart Dublin organisational structure. While a city-region body, Smart Dublin is housed in Dublin City Council's Chief Executive's Office and presently consists of four core staff members.[5] Its organisation structure is set out in Figure 2. The steering committee is comprised of two members of staff from each LA, one more technical, the other more service or enterprise focused, and it is chaired by one of the LA CEOs. It has appointed an advisory network, comprising of 40 stakeholders representing industry, government, civil society and academia, which has met once prior to the time of writing (April 2017).

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[5] Smart Dublin Regional Manager, Smart Dublin Regional Coordinator, Smart Dublin technical lead/ data lead and Smart Dublin community manager.

Figure 2: The organisational structure of Smart Dublin

Chief Executives of the four Dublin Local Authorities

Advisory Network

Members: public sector, civil society research, enterprise and technology sectors.

Functions: advice and expertise

Regional Steering Committee

Members: DRL Co Co Chief Executive (chair), two representatives from each local authority, Smart Dublin regional team and 2 representatives of Maynooth University (advisors)

Funtions: developing strategy, approving workplan, monitoring progress

Smart Dublin Regional Group

Members: Manager, Coordinator, Data Coordinator, Community Manager

Functions: developing strategy and work programme, project management, communications, open data, etc.

Local Working Groups

Members: local Smart Dublin coordinator, technical data coordinators, digital teams, key operational staff

Source: Smart Dublin Regional Group

While Smart Dublin has a particular focus and remit, it is the latest in a series of initiatives in Dublin to stimulate the growth of creative, scientific and technological clusters in the city, and foster partnerships between technology and design firms, research institutions, and the State (prior initiatives include Design Dublin, Creative Dublin Alliance, Innovation Dublin, Pivot Dublin). Its primary aim is to increase the visibility of existing smart city-related initiatives in the city region, and stimulate new partnerships and city services. Its present remit covers promoting the use of data-driven networked infrastructure, fostering economic growth and entrepreneurship, and creating citizen-centric initiatives, with a particular focus on producing

more efficient city services, improving transportation flows, tackling flooding and other environmental concerns, attracting inward investment and encouraging indigenous start-ups and SMEs, and opening data and encouraging civic engagement. It seeks to do this in a context of a limited role for the public sector in urban transformation due to the recent recession, related austerity measures, and the commensurate need to reduce the costs of public services. As a governmental unit, Smart Dublin provides a central hub for managing relations with companies and university research institutes wishing to partner with the four local authorities on smart city initiatives, and a core role of the unit is fostering economic innovation and promoting Dublin as an open, engaged business location that will accommodate urban testbedding and trialling. It seeks in part to do this by leveraging on the high-tech ecosystem formed by multinationals, SMEs and start-up companies settled in Ireland. Indeed, as they state: 'We aim to position Dublin as a world leader in the development of new urban solutions, using open data, and with the city region as a test bed.' Smart Dublin's objectives are to:

- 'To stimulate the economic competitiveness of the Dublin Region, through collaboration between private, public and academic partners;
- To drive public sector efficiencies and improve services by using the Smart Dublin platform to call out for innovative solutions to identified city region challenges;
- To promote transparency and open government through the publication of local government data on the Dublinked open data portal in open, free and reusable formats.'[6]

It continues by arguing that the benefits accrued through Smart Dublin are that it: 'acts as a reference site to validate smart city technologies; move from research to reality; builds a collaboration framework to solve Dublin's challenges; delivers more efficient and responsive city services; increased engagement with citizens and service users; [and] enhances the quality of life.' Part of the narrative supporting the work of Smart Dublin is that local authorities are behind the technology-curve with respect to state-of-the-art ideas and systems for managing cities. They

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[6] http://smartdublin.ie/about/

lack the core skills, knowledges, resources and capacities to address pressing urban issues and maintain critical services and infrastructures, which are becoming more socially and technically complex and require multi-tiered specialist interventions. Moreover, their procurement processes and regulations are outmoded and not fit for purpose. Instead, they need to draw on the competencies held within industry (such as large global consultancies and the producers of software and hardware solutions) that possess sufficient expertise to guide city administrators and can deliver better city services through public-private partnerships, leasing, deregulation and market competition, or outright privatization (Kitchin et al., 2017). Within this mindset, the place of the public sector is to challenge companies to offer solutions to set problems, and foster innovation and entrepreneurship with an open data policy and new ways of tendering. As such, what Smart Dublin provides is the bridge to source such expertise and build partnerships to keep abreast of the technology-curve and create efficiencies in public service delivery, all the while fostering a local innovation economy.

The new 'smart city ecosystem' created and promoted through Smart Dublin builds on the slogan "Open, Engaged, Connected": open as in *open data*, engaged as in *engaged citizens* and connected as in a *connected city* (joined-up and networked). In particular, Smart Dublin has pursued four tactics designed to foster 'smartness', marking a significant change in how Dublin tackles urban issues and innovation.

First, it has sought to create a *formalized approach* to engagement with stakeholders and prepare a smart city strategy. Prior to the formation of Smart Dublin there was a sense that companies and universities were formulating initiatives and the city's administration was reactive to proposals, rather the four LAs driving the smart city agenda around their requirements and those of citizens. Moreover, there was no formalised process of engagement between stakeholders, with some having better access to decision-making networks than others, with decisions being made on an ad hoc basis. As detailed by two of our interviewees:

> 'I think it would be extremely difficult … to get into DCC. I think the rigidity of policies and procurement and stuff within the council is probably the weakest point in the smart cities thing, they are not flexible enough for it. … I personally have had dealings with the council and I personally have contacts in there and I know, not necessarily who I have to talk to, but I know who I have to ask to be told who I have to talk to, and most people in

Dublin don't have that privilege. So, if you are not somebody who has had any interactions with them it is a very, very difficult place to put down any sort of a foothold.' (DSC12, leader, civic organisation)

'If you were IBM or Intel you can kind of walk through the front door but anybody else, they don't know the route or the procedure or...' (DSC23, local authority worker)

The result was a set of projects that suited stakeholders but little served the city, and which were implemented in an arbitrary way. In response to this, Smart Dublin now provides the four local authorities with a single point of contact for all smart city proposals – a 'front door' through which everyone enters – and a framing and procedure for evaluating each proposal in an equal and transparent manner. In November 2016 two sub-committees of the Smart Dublin steering group were formed to produce: (1) a formal procedure for engagement that sets out the process, timelines, and obligations with respect to Smart Dublin and those seeking engagement[7]; (2) a draft smart city strategy for discussion at the next advisory network meeting. Smart Dublin has thus been a vehicle for the four LAs to take a more active role in shaping the smart city agenda for the city.

Second, it has embraced *test-bedding* as a means to undertake urban development. Test-bedding is often synonymous with urban "living-labs" and has been introduced within engineering literature "to describe a controlled and often isolated development environment in which to test the operability of new technologies, processes, or theories for large systems" (Halpern *et al.*, 2013). Applied to cities, urban space becomes a distributed laboratory in which to test smart city technologies, especially those utilising IoT, creating test sites run by public and private stakeholder to help solve city challenges, but also to attract investment. In the Dublin case, the city allows an "exploration of smart city solutions in a space small enough to trial but large enough to prove"[8].

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[7] The initial draft of this procedure was drafted by one of the authors and was subsequently modified by other sub-committee and steering group members.
[8] The definition, firstly introduced by the Croke Park Smart Stadium consortium, has been adopted by several initiatives, included Smart Dublin, so that it became a sort of 'motto' for smart city practicioners and IoT advocates (e.g. https://www.siliconrepublic.com/machines/iot-ida-ireland-leo-clancy)

Dublin hosts test-beds in several domains, including flood management, crowd management, air quality and sound monitoring, mobility, smart lighting, and low-power wide area networks. Larger initiatives include the Smart Stadium centred on Croke Park (an 80,000 seater venue) where a number of companies are trialling sensor and camera technologies for managing the stadium infrastructure, the pitch, concession stalls, and crowds, as well as the fan experience of an event (Panchanathan *et al.* 2016), and the newly designated 'smart district', an area for trialling new smart city technologies such as sensor networks, smart lighting, smart parking, and smart grids (Heaphy and Pétercsák 2016). The latter is part of the Docklands SDZ (Strategic Development Zone), an area that is home to a number of high-tech firms, including the European headquarters of Google, Facebook and LinkedIn, as well as numerous tech start-ups and incubator spaces such as Dogpatch Labs. The 'smart district' has been the cornerstone of a bid by DCC for an EU Lighthouse project, which would provide several million euros of investment if successful.

> 'The strategy of test-bedding depends on relatively small dimension of the Irish capital: Dublin is a nice small community to work in, to start on a scale and then, when we have something right, we can take it somewhere else. We will start a trial soon in New York City and that has the potential to be much, much bigger. But we have the understanding of what it takes from having a nice local small scale here, and we have a very clear picture so that when we go to talk to somebody new they can see that we understand the problems or understand what is needed.' (SD30, start-up entrepreneur)

From the Smart Dublin perspective, test-bed urbanism is an opportunity to scale from the bench and lab to the street and urban environments, and to collaborate with other like-minded operations, including start-ups, SMEs and multinationals. The aim is twofold: to draw in investments and actors who are developing new technologies, and to deliver new and more efficient services.

> 'Now what the city government should do, in my opinion … is two things. They should obviously look at how it can test, exploit and deploy technology solutions to improve lighting, to improve traffic management, to improve flood safety. But then it should

also look at how it can actually play at the edges of all that to allow universities to do research and businesses to test market products that they could have developed somewhere else but they want to see them in a real-life scenario.' (DSC5, administrator, local authority)

However, it also recognizes that test-bed urbanism is an open-ended model based on experimentation, uncertainties and trials (Halpern et. al. 2013). Dublin is no exception:

'But again it is about building up slowly and not just leaping in and trying to put out a massive network of sensors and then go, what are we going to use them for? [...] It should be about iteration. We should be able to put out some relatively small numbers, learn from them. And you will, you will learn loads of stuff about what is going right, what is going wrong.' (SD30, start-up entrepreneur)

The indefinite endpoint and progressive re-adaptation make test-bedding consistent with the future-oriented nature of Pre-Commercial Procurement (PCP), particularly in the form of '*procurement by challenge*' and Small Business Innovation Research (SBIR), which is the third tactic Smart Dublin is adopting. PCP has been recently adopted by the EU to foster ideas where a substantial amount of research and development is still needed to obtain a final product or service. [9] The process does not presuppose the optimal solution to a problem for which tenders are then sought, but rather seeks a range of solutions from which one will be selected. In many cases, an already established market solution does not exist, with the selected solution needing to be developed from an idea through to product. Usually the process is divided into four phases. First, a 'challenge' is identified and a competition initiated. Second, the submitted solutions are evaluated and whittled down to four to six proposed solutions that the judging panel determine have potential value and utility. Each of the entities developing these solutions are given seed

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[9]"By definition, pre-commercial procurement is limited to the "pre-commercial" phase of an innovative product's lifecycle, while the commercialization phase is left in the hands of private firms and agents [...] This does not rule out the possibility (i) of a prototype or a test series being produced during the pre-commercial phase; and (ii) of the public procurer being among the purchasers of the commercialized good/service (or even the only purchaser, in the event of an exclusive development contractual clause)" (Petrella 2013).

funding to continue to work on and prototype their solution. Third, a further round of judging takes place to identify the solution that is most likely to best address the challenge proposed. The successful initiative is given a further round of funding to develop their solution to a market product. Fourth, the LA decides whether to procure that product for mainstream use in the management of the city. Administered in this way, procurement by challenge acts as a stimulus to innovation, business and product creation. The project is inherently risky to both the procurer and developer as ultimately a solution for a problem might not be achieved. Despite this risk, the venture is considered worthwhile because it supports an innovation economy.

Smart Dublin has actively embraced the procurement by challenge approach to urban innovation and finding solutions to issues that Dublin faces. To fund PCP, Smart Dublin has successfully applied for SBIR (Small Business Innovation Research) funds from Enterprise Ireland (the state agency responsible for developing and supporting indigenous companies). SBIR operates under EU pre-commercial procurement rules and is a pan-government, structured process, enabling the public sector to engage with companies, especially start-up companies operating in the high-tech sector.[10] To date, one 'challenge' is significantly underway, focused on increasing cycling take-up in Dublin, making it safer, more sociable and secure.[11] Three more focused on illegal dumping of waste, flood management, and assisted wayfinding have been launched in April 2017.

Lastly, Smart Dublin is seeking to leverage a *scale change*: a shift from localized authorities to the Dublin city-region scale as a joint endeavour of the four LAs. This scaling helps to bridge the fragmenting of governance and administration across the city and facilitates the sharing of knowledge between actors. By providing a one-shop stop for all stakeholders interested in smart city initiatives for Dublin, Smart Dublin acts as a broker between companies, universities and the local authorities. While most attention is usually directed at DCC, which covers the the city centre, Smart Dublin informs stakeholders of opportunities with the other LAs and can provide introductions. A shift in scale also potentially creates scales of economy for financing and implementing smart city technologies that work optimally at city-scale, rather than

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[10]SBIR (Rigby et al. 2012) aims to support the Public Sector to address challenges through innovation in products and services. SBIR projects are 100% funded, create a lead/R&D customer, provides accountability for funders and the IP is owned by companies that are free to develop and sell their innovations in global markets.

[11] Out of the 93 application received, 21 have been audited, 5 selected for the first phase of funding (12.500 euros each) and 4 selected for the second phase of funding (25.000 euros each).

in localised areas. A further two scalar transformations are also occurring. The first is to an all-island scale through the All-Ireland Smart City Forum (launched December 9th, 2016) that includes all the major cities of Ireland, and possibly those of Northern Ireland too, in order to share best practices, coordinate projects and tenders, and make collective bids for funding. The second is international and involvement in an EU H2020 project, an Urbact project (EU European Regional Develop Fund), a lead participant in a EU lighthouse project bid, and membership of TM Forum (an organisation that promotes the use of digital business in general across government, including smart cities) that involves collaboration with other city administrations in Europe and with businesses globally.

Thus conceived, Smart Dublin is an effort to coordinate, build and extend innovation networks in Dublin, closely linked to multinationals, the active start-up community, and state-funded drives to support local enterprises. Indeed, it is important to note that Smart Dublin has no control over the many smart city initiatives across the four local authorities. Rather its role is one of articulation (creating a smart city narrative and strategy), initiation (introducing and seeding new potential projects, partnerships, and systems into the four local authorities), and promotion (selling the idea that Dublin is a smart city and is open for smart city initiatives and businesses). These serve four main purposes. First, addressing and removing some of the barriers that were creating fragmentation and holding Dublin back from becoming a smart city, such as a lack of cooperation, joined-up thinking, weak governance and leadership, and an absence of formalized engagement. Second, creating, promoting and maintaining a discourse where private and civic initiatives in the Dublin region can coalesce. Third, putting Dublin 'on the map' of global smart cities. Fourth, providing a platform for engagement with new tendering practices.

From 'accidental to 'articulated' smart city?
At the time of writing, it is a year since Smart Dublin's formal launch and couple of years since its inception. In that time, with a small team and limited resources, Smart Dublin has started to shift Dublin from being a purely accidental smart city to an articulated one; that is, from a situation in which there were various disconnected and uncoordinated smart city initiatives, to one where there is a narrative placed around those initiatives and there is a unit whose role it is to envisage and help realise Dublin as a smart city. Its orientation to this process of articulation has very much been focused around economic and urban development, practising a form of tech-led

innovation entrepreneurial urbanism in which city assets are used to increase competitiveness, attract inward investment, and foster indigenous start-ups and SMEs. In many senses, Smart Dublin is remaking the actually existing accidental smart city in a new form through testbedding, procurement by challenge, and scaling. Here, Dublin as a smart city is being articulated as 'open, engaged, connected', but how this plays out on-the-ground is somewhat different to that hoped for. Rather than the smart city being 'open as in open data', 'engaged as in engaged citizens', and 'connected as in a connected city', it is 'open as in open ended or open market', 'engaged as in otherwise engaged', and 'connected as in loosely coupled'.

Testbedding and procurement by challenge are explicitly open-ended, ad hoc processes, seeking to foster innovation and creativity, and to conceive, build and test new urban solutions iteratively. Smart Dublin is actively pursuing 'experimental urbanism' (Evans et al. 2016) as an economic growth and urban development strategy, offering companies access to city services, infrastructures and personnel in a form very different to the usual relationship between companies and city administrations. While the process of testing and trialling is supposedly meant to be leading to fully implemented and mainstreamed systems, investments in experimental urbanism runs the risk of parts of the city becoming eternal 'beta versions'. Of course, cities are always in the process of becoming, unfolding in time and space as a diverse set of processes that shape city life and urban development. However, city administrations usually seek stability and certainty, updating systems as and when needed, rather than encouraging continual flux and first-mover risks in adopting urban technology. With respect to the latter, urban spaces and city management are further repositioned as open markets in which companies can co-create and work with the State, deepening and further legitimating the marketization and public-private provision/privatization of city services and infrastructure. Rather than the city being a place which facilitates and hosts markets, with local government and state agencies being the main provider of services, the city itself becomes a market and corporate laboratory, with services increasingly being delivered privately. Such a repositioning raises the question of for whom is the smart city is being developed? What is the role of the State in urban development? How does the smart city unfold in practice through public and private means? In the case of Smart Dublin these normative questions have little been considered or debated beyond formulating broad mission statements and goals. Rather the smart urban development agenda is

being driven by a relatively narrow instrumental agenda aimed at addressing specific issues and fostering economic development.

While Smart Dublin professes to engage citizens, with citizens being considered its 'most important component', its focus on test-bedding and procurement by challenge has meant that in practice it has been almost exclusively engaged with companies, other state agencies, and departments in the LAs. Indeed, Smart Dublin has mostly been focused on building a platform to enable market collaboration and supporting economic growth and competitiveness. In part, the emphasis on economic development has been driven by a strong government emphasis on job creation and economic recovery post-financial crisis. Facilitating urban test-bedding is positioned as a strategic asset to attract inward investment and procurement by challenge is supported by a government funding stream. In addition, the loss of resources, staff and expertise within the public sector in the wake of the crisis necessitates a turn towards the market for ideas, labour and solutions. Given this limited capacity, the market is seen as a much more likely source for innovation and workable solutions than citizens. Moreover, given already existing relationships and the ecosystem of companies and incubators, engagement with the private sector is easier to manage and more straightforward. In contrast, interacting with citizens and civic associations is more complex.

In other words, there has been a pragmatic approach taken as to whom to engage with given government priorities and Smart Dublin's own limited capacity. This has meant that citizens are only the 'most important component' in the sense that ultimately, they will be the beneficiaries of the smart city – receiving better services. Indeed, the role of citizens in Smart Dublin is presently one of user or consumer or tester, but not consultant, participant, proposer, co-creator or decision-maker. Indeed, to date there has been little attempt to actively engage citizens with respect to Smart Dublin's work: there is no sense that test-bedding has been undertaken in partnership with local communities or that citizens are actively consulted in identifying the challenges to be addressed through the SBIR programme. As such, with regards to citizens Smart Dublin has defaulted to operating a form of civic paternalism and stewardship deciding on what is best for and acting on behalf of citizens (Cardullo and Kitchin, 2017). And despite the ambition to become more citizen-centric, the marginal status of citizens in creating the smart city is likely to remain in the absence of additional capacities and competencies of

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Smart Dublin to engage meaningfully with them, or an agenda driven by normative rather than instrumental concerns.

While Smart Dublin spans the four local authorities and in principle could act as a coordinator of smart city initiatives within and across these bodies, to date it has concentrated its focus on creating connections with and between companies and university research institutes. In this sense, it has created connections, but they are outward facing linkages rather than inward. Moreover, given the heterogeneity of actors (start-ups, corporations, public agencies, universities, etc.), the mutable nature of markets, and the lack of capacity and leadership, rather than a producing a highly and tightly connected network Smart Dublin works within a loosely coupled ecosystem (Weick 1995). Such an ecosystem is characterised as being without central coordination nor strict rules, where there are many solutions to challenges, processes are distributed in a dense network of connections, and feedback is not immediate. Smart Dublin seeks to be a facilitator within these loose couplings, organizing and sponsoring meetings, running events and schemes, providing funding and space, and acting as a broker between actors. It makes Dublin's ecosystem visible and at the same time acts as a platform for it. However, the looseness of arrangements mean that the network lacks coordination and direction, meaning that how the activities unfold can be haphazard and dependent on particular individuals rather than structures and formalised processes. As such, the scale and success of initiatives is variable according to the relations and actors that are activated around specific challenges, technologies and solutions.

One issue that is significantly shaping the formation and geography of new smart city initiatives in the city is a large imbalance in the enthusiasm, commitment and resourcing by the four LAs. While each local authority has smart city initiatives, DCC has by far the most number of staff interested in and actively applying the smart city approach, and the greatest number of projects and connections with companies. They were the initiators of test-bed urbanism within the city as well as of the pre-commercial forms of procurement, and are driving those agendas. They are also the largest and wealthiest LA given the business rates generated by the city centre location. What this has meant is that Smart Dublin is dominated by DCC and the organisation sometimes suffers with the associated politics and disharmony that go with this imbalance, such as difficulties in agreeing on courses of action.

The orientation of Smart Dublin towards economic development and innovation has meant Dublin is being articulated as a smart city in particular way. However, while the approach adopted produces a narrative of Dublin as a smart city and has been successful in terms of encouraging innovation, building relationships with companies and universities, and starting to establish an international profile needed to secure large-scale EU smart city funding, it does very little to address the accidental nature of existing smart city initiatives, which remain largely disconnected and uncoordinated. Moreover, somewhat ironically, the approach of using testbedding and new forms of procurement further produces a fragmented landscape of ever-evolving projects and initiatives that are in continual flux. These testbed and procurement related projects possess coordination in so much as they are facilitated by Smart Dublin, but they are not interlinked through some grand design or master plan that addresses issues of interoperability between systems and alignment of work and processes with existing initiatives. Indeed, most are pilot projects that will not be mainstreamed in the short term. Further, while new forms of procurement potentially make the public sector more agile and responsive to market solutions, it also makes it more fragile in two ways. First, it further delegate responsibility for the delivery of city services to the private sector. Second, due to their reliance on networked software, the technical solutions procured are potentially insecure, brittle and open to hacking (Kitchin and Dodge 2017). As such, Dublin is set to continue being an accidental smart city, albeit one whose accidental nature is veiled by Smart Dublin. In this regard, it will not be exceptional. As Paul Dourish (2016) notes, every city is an accidental smart city, though some are more articulated, and some more coordinated, than others.

Conclusion

In this paper, we have examined the accidental nature of smart city development and how the diverse processes and initiatives of smart cities are corralled within an articulated narrative to produce a more coherent sense of the smart city landscape forming. Our case example has been Dublin, Ireland, and the formation of Smart Dublin, a unit co-owned by four LAs whose remit is to articulate a smart city narrative and strategy, initiate new projects and partnerships and attract funding and inward investment, and promote the work of the Dublin LAs within and beyond Ireland with respect to smart cities. As with all existing cities that are utilising ICT in their management and governance and delivery of city services and infrastructures, our mapping of

the various smart city initiatives at work in Dublin reveals that they were deployed in an ad hoc, piecemeal, uncoordinated manner. There was no smart city master plan. In fact, there was very little coordination or even awareness of initiatives across departments with LAs or between LAs. Smart Dublin has sought, in part, to address this accidental nature and to create a more articulated and coordinated smart city landscape. However, while Smart Dublin has been successful in creating a smart city narrative and branding Dublin as a smart city, it has taken a very particular path in this process, focusing strongly on economic and urban development. To a large degree, Smart Dublin operates as an economic support unit, forming partnerships with companies and universities to facilitate urban testbedding and attract inward investment, and experimenting with procurement by challenge to foster innovation, new smart city products, and new business formation. It has little addressed the existing accidental and uncoordinated nature of Dublin as a smart city and in many ways actively contributes to that accidental nature through proliferating smart city projects that are largely uncoordinated and non-interoperable beyond a shared, overarching narrative. The accidental smart city then continues to be produced, despite the attempts to create a more articulated vision.

The contribution of this analysis to understanding the smart city is threefold. First, we have demonstrated the importance of mapping the whole smart city landscape within an urban domain. Such a mapping reveals that despite the rhetoric of smart city initiatives breaking down silos and producing more coordinated, integrated city services, in reality initiatives are largely conceived and built in a gradual, piecemeal manner by different parties, and are deployed under the control of varying actors. Few cities so far have developed smart city strategies or masterplans, and despite the projected hopes of urban operating systems, integrated control rooms, and smart city standards initiatives, the smart city will largely continue, we believe, to be accidental rather than by design. No doubt, integrating solutions, standards and strategies will produce a degree of coordination and interoperability, but it will not be able to tame and corral all the stakeholders, actors and technologies at play in the city into a unified whole. As such, the articulated smart city will always to be that, an articulation: a narrative to create a particular impression and to attract attention and investment. It will always remain to some degree accidental.

Second, we have demonstrated the role of the political and administrative geography of a city in the development of smart cities. In particular, we have highlighted how the fragmented

nature of Dublin's local government into four autonomous jurisdictions contributed to the accidental nature of its smart city initiatives. The solution to this fractious governance was the formation of a unit that cut across all four LAs, with a shared budget and staff. However, while the unit does overarch the LAs, it has no executive powers of coordination, only able to lobby LA departments to embrace the ideas and ideals of smart cities and use Smart Dublin to promote Dublin as a smart city. To date, there has been very little political geography analysis of the smart city beyond a number of studies that examined the modes of governmentality enacted through smart city technologies (e.g., Klauser et al. 2014; Vanolo 2014; Sadowski and Pasquale 2015; Luque-Ayala and Marvin 2016). And yet it is clear that the administrative geography can have a profound effect on the deployment of smart city technologies that need to work at scale or across stakeholders. For example, transport solutions such as integrated smart ticketing, smart parking and bike-share need to cover entire functional territories and all suppliers. It is unfeasible that citizens would be expected to transfer between different bike systems at municipal boundaries or have different smart cards for different transport providers. Moreover, it means that there can marked differences in the smart city services that citizens have access to in different jurisdictions. This is the case in Dublin, but is particularly striking in another of our case studies, where the number and scope of smart city initiatives across the 101 municipalities in the Greater Boston area is highly uneven and there is little to no cooperation and sharing between jurisdictions. In part, this issue has been ignored because studies have focused on single technologies within single jurisdictions.

Third, we have documented the process by which an accidental smart city starts to become an articulated one and the role played by specialist smart city units. Smart Dublin's role is explicitly to produce a smart city strategy and narrative, to liaise and work with companies, universities and other LA departments and public sector agencies, and to seek new solutions for issues facing LAs and citizens; it is to create an articulated smart city. It is highly active in this regard, acting as a key node in the advocacy coalition for smart cities (Kitchin et al., 2017) operating in the city, and liasing and working with international partners. Given limited resources and a wider context of government prioritising job creation and the priorities of companies, Smart Dublin is pursuing becoming an articulated smart city through an economic development agenda that utilises test-bedding and procurement by challenge, but as yet pays little attention to meaningful citizen engagement. As a shared unit across four LAs, Smart Dublin

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is somewhat pioneering in the Dublin context, creating a distinct form of governance. The unit has quickly gained visibility across departments in the four LAs though the challenge workshops it has organized, and it has gained some international visibility. It acts a conduit for mobile policy concerning smart cities into the four LAs and as a broker for projects between stakeholders and LAs.

It is clear from our analysis that to more fully understand the rollout of smart city initiatives around the world there is a need for two complementary sets of studies that supplement the raft of studies focusing on the rollout of specific technologies or initiatives in particular locations. First, there needs to be empirical case studies of the evolving smart city landscape across entire city-regions, the interrelationships between smart city initiatives, the role of political and administrative geographies in shaping the development of the actually existing smart city, and the formation and work of smart city units. Clearly, such research can draw on the rich tradition of urban policy and practice research to contextualise and help make sense of what is the same or different about the drive to create smart cities. Second, there needs to be a set of comparative studies examining how the smart city landscape is taking shape in different cities around the world and starts to make sense of general patterns and localised contingencies. It is clear from the analysis conducted to date that the creation of smart cities has taken different paths and forms across the globe, varying as a function of political, economic and legal context, culture, governance, legacy infrastructures, policy priorities, administrative geographies, and interconnections and interdependencies with other places. Little is known, as yet, as to the specificities of these differences and their effects, and yet smart city technologies are still being developed and marketed as universal solutions to urban issues.

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