

Smart City as Anti-Planning in the UK

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Abstract

Critical commentaries have often treated the smart city as a potentially problematic ‘top down’ tendency within policy-making and urban planning, which appears to serve the interests of already powerful corporate and political actors. This article, however, positions the smart city as significant in its implicit *rejection* of the strong normativity of traditional technologies of planning, in favour of an ontology of efficiency and emergence. It explores a series of prominent UK smart city initiatives (in Bristol, Manchester and Milton Keynes) as bundles of experimental local practices, drawing on the literature pointing to a growing valorisation of the ‘experimental’ over strong policy commitments in urban governance. It departs from this literature, however, by reading contemporary ‘smart experiments’ through Shapin and Schafer’s work on the emergence of seventeenth-century science, to advance a transhistorical understanding of experimentation as oriented towards societal reordering. From this perspective, the UK smart city merits attention primarily as an indicator of a wider set of shifts in approaches to governance. Its pragmatic orientation sits uneasily alongside ambitions to ‘standardise’ smart and sustainable urban development; and raises questions about the conscious overlap between the stated practical ambitions of smart city initiatives and pre-existing environmental and social policies.

Key words: urban experiments; smart city; sustainable cities; urban governance; experimental governance

10,478 words including abstract and references

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Introduction

The international rise of ‘smart city’ policy-making has been widely documented. But what is the relationship between the smart city and traditional processes of urban planning and management? One line of enquiry into this question identifies a problematically technocratic tendency in discourses through which large technology companies have promoted the smart city. In Söderström’s et al. (2014) analysis, for example, the ‘engineering epistemology’ and ‘systems thinking’ underpinning this discourse is rhetorically ignorant of local political contingencies. The present article, however, approaches the UK smart city as a body of practices emerging at local level, typically located only on the fringes of mainstream institutional power. Its significance as a ‘technology of power’ (Foucault, 1991) is not inferred from its tangible ‘top-down’ effects on urban space or bodies, but rather in its status as a paradigmatic symptom of broader, ongoing attempts to reshape modernist governance rationalities. The article explores the possibility that the smart city challenges, rather than merely enhances, more conventional planning and policy mechanisms to address social and environmental problems.

To make this case, the article builds on the growing literature around urban ‘governance by experiment’, focusing on the nature and implications of the smart city’s experimental qualities (Evans et al., 2016a). While commentators are typically quick to distinguish contemporary ‘urban experiments’ from natural scientific experimental ideals and traditions, a key aim here is instead to draw attention to certain commonalities. Underpinning this comparison is an understanding of both ‘scientific’ and ‘urban’ experiments as seeking to produce specific *types of knowledge*, with broader social and institutional significance in that “Solutions to the problem of knowledge are solutions to the problem of social order” (Shapin and Schaffer, 2011: 332).

If urban experiments – exemplified by the smart city – represent a particular “modality for the exercise of power over urban spaces and populations” (Evans, 2016:432), this article suggests that the UK smart city serves to contest the nature of this relational power, as much as it works to achieve predetermined transformational effects on the city. It argues that the power unfolding through the smart city is not technocratic, as the early critiques of its corporate envisioning propose, so much as *disruptive*. That is, the smart city does not entrench or simply complement existing processes for achieving given social or environmental goals, but rather – by analogy with the notion of disruptive business model innovation (Markides, 2005) – is oriented towards supplanting those processes. The ‘smart’ label itself is likely to be transient. Its potential legacy, however, of experimental governance logics with unsettling effects on urban planning, invites ongoing critical attention in future.

Although this article is primarily concerned with broad questions about the relationship between the smart city and more established technologies of planning, it simultaneously promotes the need to make sense of this relationship in specific contexts. Moving away from a reading of the smart city as a straightforward imposition ‘from above’, our starting point is that the unfolding ‘actually existing smart city’ (Shelton et al., 2015) is characterised by localised variety. This variety is understood as co-produced by its local, national and international context; and arising through messy social, technical and political processes (Barns, 2016), rather than determined by global or national policy discourse (Shelton et al., 2015; Cowley et al., 2018). Instead, smart city discourse is treated as a justificatory narrative (de Jong et al., 2015; Söderstrom et al., 2014) which catalyses and lends coherence to variegated practices at local level. The article reflects on the emergence of concrete programmes of activities at local urban level in one country (the UK), but also suggests that the experimental logics which they hold in common, and which are partly constituted by their pragmatic embedment into varied local contexts, may potentially shed useful light on smart city development elsewhere.

Evidence is drawn from three UK cities in particular (Bristol, Manchester, and Milton Keynes). These three cities were selected from a national survey of smart city policies and activities (Caprotti et al., 2016), on the basis that each has a relatively well-developed programme of publicly documented smart city activities taking place. The analysis presented here is primarily based on a survey of publicly available policy, corporate and (where contextually appropriate) grassroots organisation documents and reports on the specific smart and digital urban initiatives, projects, strategies and visions in each of these cities.¹ For the purposes of triangulation, and to corroborate the authors’ understanding, eight interviews were also conducted between November 2016 and March 2017 with key actors (from local authorities, technology companies, universities, and coordinating organisations) in Manchester and Bristol. These interviews ranged from 32 to 58 minutes in length, and were digitally recorded and transcribed prior to analysis. Seven were conducted face-to-face at interviewees’ offices or places of work, and one by telephone.

After outlining some of the key theorised characteristics of contemporary experimental governance, the article introduces the three example cities by briefly outlining their varied smart city activities and the differing policy narratives within which these are subsumed. The intention is not to provide full profiles of these three cities, nor to claim that they fully exemplify the variegated nature of smart urban practices across the UK. Rather, more than one city was used to inform the discussion simply to highlight the fact of local variety, which underscores the limits of a ‘technocratic’ reading of the smart city. If, nevertheless, it is accepted that these three examples collectively indicate the ‘cutting edge’ of smart urbanism in the UK, we propose that certain similarities observable across the three cases are indicative of broader contemporary UK trends. We observe that the ‘actually existing’ UK smart city displays coherence in certain commonalities of rhetorical presentation, practices, and governance arrangements, which actively align it with the tendency towards urban experimentation. By interpreting these urban experiments through the lens of Shapin and Schaffer’s (2011) classic study of 17th century science, we

¹ A list of the documents consulted is publicly available at [PROJECT REPOSITORY URL]

suggest that they share certain characteristics with experiments conducted in line with a traditional scientific ideal. These shared characteristics are outlined in terms of: the ideal of replicability, the importance of demonstration and consensus-building, the reworking of societal spheres, contestations over boundaries, policing and promotion, and rhetorical humility. This transhistorical understanding of experimentation accentuates the role of smart city activities in catalysing processes of broader societal and institutional reordering.

Specifically, we speculate that the epistemological orientation of smart city experiments directly challenges, rather than simply complements, the institutional basis and normative project of planning the future city. In the article's final main section, this 'anti-planning' orientation is elicited through a discussion of a further common characteristic of smart city activities: their rhetorical alignment with long-term sustainable development goals. The article concludes by inviting readers to consider the relevance of our UK-based argument for smart city practices and urban planning elsewhere.

Characteristics of contemporary urban experiments

Various recent attempts have been made to articulate a broad shift towards 'experimentation' in governance, particularly at the urban level.² Among both practitioners and scholars, the notion of the urban experiment has gained considerable currency, with urban space treated as both 'field site' and 'laboratory' for trialling and understanding new innovations and their governance implications (Evans, 2016; Caprotti and Cowley, 2017). Metaphorical presentations of city space as a 'field' or 'lab' are far from novel (Gieryn, 2006). Nonetheless, urban experimentation is currently embraced as both a theoretical lens and a mode of intervention into fields where change would previously have been driven by conventional policy processes.

Studies of climate change governance identify a global trend towards 'experimental' urbanism (Bulkeley and Castán Broto, 2013). Such experiments differ from earlier municipal responses to climate change (which relied on traditional planning and policy mechanisms), in their tendency to be more "fragmented", attached on a "case-by-case" basis to other agendas, and in their opportunistic reliance on discrete event-related and funding opportunities (Bulkeley and Castán Broto, 2013: 362-363). Their implementation exceeds "existing channels of political authority" (364), and is characteristically "tentative" (363), rather than "'planned' by governmental action in a linear way, from intention, to plan, to outcome as planned" (Healey, 2006: 3). As Stead (2016) observes, the risk of failure circumscribes the appeal of experimenting for policy-makers, and yet the intention to 'learn lessons' may be served regardless of immediate outcomes. Thus, urban 'governance by experiment' characteristically emphasises social learning and iterative design processes, in conditions of uncertainty (Sengers, Berkhout et al., 2016). The strong normativity of conventional policies is dislodged by a purposive intent "to simulate a complex process of social and technological co-evolution with emergent properties" (ibid: 17).

² The terms 'urban', 'local', and 'city' are used synonymously in this article.

The ephemerality of some urban experiments may appear to imply their structural insignificance: they may, variously, be small-scale, of limited duration, and unsupported by firm commitments to wider application. Alternatively, it is precisely their peripherality and dynamic flexibility which enables them potentially to pose challenges to established ways of working. For Hoffmann, 'climate change experiments' worldwide – whether associated with particular cities or not – constitute “a process of making rules outside well-established channels” (Hoffmann, 2011:18). His experiments describe “diverse activities engaging a wide range of actors” (44) extending beyond “traditional political authorities” (28). Crucially, such experiments “generate friction by pushing the boundaries of traditional notions of which actors are responsible for making rules, creating uneven sets of rules that actors must follow, and generating new coalitions” (28).

The various attempts to capture these new experimental approaches typically proceed by distancing them from ideals of experimentation rooted in the natural sciences. Thus, Halpern *et al.* (2013: 274) characterise the 'test-bed urbanism' of large-scale greenfield smart city projects such as South Korea's Songdo as “unlike the older forms of Enlightenment science”. Bulkeley and Castán Broto (2013: 363) clarify that they “do not use experiment in the formal scientific sense of the term”. Sengers' *et al.* (2016) review of the academic literature around socio-technical transitions opens by contrasting 'socio-technical experimentation' with the idea of experiments as “practice that takes place in the confines of a laboratory or an otherwise strictly controlled environment as a way to find hard objective truths about material reality” (Sengers, Wieczorek, *et al.*, 2016:1). Elsewhere, Ansell and Bartenberger (2016) distinguish two broad 'experimentalist' approaches to addressing environmental concerns. The first, associated with economics and ecology, evokes a traditional laboratory whereby “conditions are controlled to isolate the effect” of purposive interventions (64). The second, common among practitioners, policy-makers, and built environment specialists, exhibits logics of “innovation and design”, more loosely describing a “novel attempt to solve a problem” (65). They do not claim that these goals necessarily exclude each other; and yet once again the analytical work is oriented towards conceptually distinguishing 'urban' from 'scientific' experiments.

Defining urban experiments in opposition to scientific experiments reproduces a binary understanding of two privileged 'truth spots' (Gieryn, 2006) – the lab and the field – with urban experiments more obviously associated with the latter. In Gieryn's (2006: 6) reading, laboratories are legitimised by their walls, while the 'field' provides access to “unadulterated reality”, such that the “lack of control becomes its own virtue”. But while the pursuit of knowledge through scientific experimentation is one of the “outstanding characteristics of modern society” (Gross, 2009), what Rheinberger (2006: 4) calls “post-modern” experimentation is defined precisely by its conscious blurring of the imagined boundaries between the abstracted facts of the laboratory and the embedded values of society. In parallel, the laboratory itself has increasingly been theorised as a social practice (Dorstewitz, 2014) rather than idealised as a walled-off space of abstract knowledge (Gross, 2009). The nature of the 'boundedness' of urban socio-technical experiments remains undertheorised (Caprotti and Cowley, 2017), but it is precisely this blurring which legitimates contemporary experimentation as a means of dealing with *uncertainty* (Evans, 2016; Gross, 2009; Kullman, 2013); its provisional, adaptive approach differentiates it from a modernist experimental mindset (Evans, 2016; Kullman, 2013).

The work of distinguishing urban experiments from the 'scientific method' is predicated on the need to define the former as a characteristically contemporary object of study. Focusing on the situated significance of urban experiments entails emphasising their local embedment (Williams, 2016) and relating them to "context based theories of change" (Castán Broto, 2017:10). The analytical work of transition theorists, for example, traces contingent discursive, material or institutional factors that prevent or enable the emergence of innovations from particular spatio-temporal 'niches'. Here, however, we advance a more transhistorical understanding of experimentation, in which no particular type of experiment is understood as inevitable, but rather as always reliant on active work to construct a historically contingent set of norms. Accordingly, the distinctive features of its contemporary form direct attention to what these intended norms might be, and what societal agendas they speak to. In other words: "If experimentation is increasingly being selected as the 'appropriate' response to urgent needs or uncertain circumstances what does this tell us about today's urban problematic?" (Evans, 2016: 438).

This is a key question: Shapin and Schaffer's (2011) influential thesis on the modern scientific method in the seventeenth century (and its roles in stabilising post-Reformation society) linked the early history of scientific experiments to the maintenance of societal order, and the emergence of modern democratic institutions and norms (Shapin and Schaffer, 2011; Jasanoff, 2015). The particular technical, literary and social technologies invoked to legitimise the truths thus produced were not assured so much as hotly contested (Shapin and Schaffer, 2011). And this conceptualisation of experimentation's performative ordering role in society has relevance beyond the context of seventeenth-century science. It resonates, for example, with the observation that twenty-first century markets are consciously constructed through 'economic experiments', and therefore "increasingly presented as experimental artifacts" (Muniesa and Callon, 2007:164). It predicts that the normative orientation of urban experimentation has been shaped by particular social and political contexts, and therefore that the social and political significance of urban experiments extends beyond the creation of useful practical knowledge. If, furthermore, the earlier formation of a particular 'experimental form of life' described "the origins of a relationship between our knowledge and our polity that has, in its fundamentals, lasted for three centuries" (Shapin and Schaffer, 2011: 341), then we should be alert to the potential for new forms of experimentation to pose challenges to this status quo in their turn.

This article offers some reflections on the nature of these challenges. First, though, it aligns UK smart city activities with the trend towards urban experimentation outlined above. This alignment is evidenced by the variety of the opportunistic projects emerging, their peripherality to mainstream policy-making, the fluidity of their governance arrangements, and the language characteristically used in their promotion.

The UK smart city landscape

Recent research suggests that almost a third of the UK's urban areas with populations of over 100,000 currently have clear ambitions and/or substantial programmes of current activities labelled as 'smart' (Caprotti et al., 2016). Reflecting the growing importance of smart city discourse among different groups

of actors, the British Standards Institute (BSI) has developed national standards and guidelines which “help address various issues for a city to become a smart city” (BSI, undated). At this stage, however, the smart city remains characterised by fluidity and variety at local level – both in terms of practices and precise governance arrangements. Rather than flowing from a preliminary process of policy envisionment, as the European Parliament’s (2014) classification of smart city ‘maturity’ predicts, actual projects are more readily characterised as having emerged mainly in ad-hoc, opportunistic ways. Some indication of this variety is provided below with reference to three cities’ broad policy framings and current activities.

Bristol

Bristol consciously builds on its image as a centre of grass-roots innovation (Torrens et al., 2018), boasting “a reputation for having a vibrant culture, strong community identities, with lots of people willing to volunteer their time to create a better place to live” (Bristol City Council, 2012: 6). Its smart city ambitions have been positioned as targeting health and wealth inequalities and the need to ensure high quality of life for a rapidly growing population (ibid: 1) in what the City Council’s Innovation Manager has declared the “most productive city economy outside of London”, and a “super connected city” where “people and behaviour are as important as technology” (Wilson, 2015). Its smart activities, promoted by the ‘Connecting Bristol’ umbrella organisation, include various digital infrastructure projects, most notably through the ‘Bristol is Open’ initiative, supported by a mixture of local, national and European grants, academic research funding, and private sector investment (Bristol Is Open, undated a); and a recently opened ‘operations centre’ coordinating traffic, public safety and emergency response systems. Connecting Bristol also encompasses a wide range of mostly NGO-led projects, more obviously aimed at public engagement and social inclusion (Connecting Bristol, undated a). These include a series of pilot apps developed under the EU-funded ‘IES Cities’ scheme, including a local social media platform, and ‘YouDecide’, enabling participation in neighbourhood decision-making and council surveys; the annual ‘Playable Cities’ award for temporary artistic installations; and the planned ‘Bristol Approach to Citizen Sensing’, aiming to develop a “‘city commons’ that supports the deployment of new or adapted technologies into everyday environments” (KWMC, undated a: 1).

Manchester

Manchester is building on the legacy of its digital strategies published in 2008 and 2012, and the now disbanded Manchester Digital Development Agency, established in 2003. Its 2012 bid for funding to develop a ‘Future Cities Demonstrator’ programme framed its smart aspirations as consolidating the growth of its hi-tech industries, infrastructural investments, and repopulation of the urban core, while presenting a ‘defining vision’ of the city as “the birthplace of the industrial revolution re-inventing itself as a model of 21st century ‘green growth’” (Manchester City Council, 2013: 8). Its smart activities are concentrated most obviously in the ‘Corridor Manchester’ area south of the city centre. Two are particularly prominent at present. Manchester is one of several cities participating in the five-year European Commission-funded ‘Triangulum’ project, aiming to integrate ICT, mobilities and energy systems around local infrastructural assets. In parallel, ‘CityVerve’ is a national government-funded two-year initiative to “demonstrate applications of Internet of Things technologies and services in four key areas: healthcare; transport; energy and environment; and culture and community” (UK Government,

2015). Meanwhile, the council's recently launched 'Smarter City Programme' collates various activities already implemented or planned across Manchester (Manchester City Council, undated a). These include a city-wide sensor network; a drop-in centre at the Central Library providing access to and education about digital technologies; the city's 'Open Data' initiative; a monthly 'EcoHome Lab' meeting for those wishing to use "open-source hardware and software to gain a better understanding of energy in [their] homes" (Manchester City Council, undated b); and grassroots 'MadLab' digital innovation organisation.

Milton Keynes

In aiming to become the UK's "leading digital city" (Milton Keynes Council, 2012: 10), Milton Keynes consciously draws on a history of innovative urban planning, as the best known example of the UK's post-war 'New Towns' (ibid: 3). Its MK:Smart 'Future City' programme links technical innovation to goals of ongoing infrastructural and environmental improvements (MK:Smart, undated a). The project budget of £16m, half of which was awarded by the Higher Education Funding Council for England, is being invested in projects including: demonstrator and pilot infrastructural projects; programmes of workshops, courses and hackathons aimed at entrepreneurs; and the 'Our MK' online platform which crowdsources ideas and funding to "support people to play an active role in urban innovation" (MK:Smart, undated b). MK:Smart is organised around the 'MK:Data Hub', which collates data from key infrastructure networks, environmental sensors, social media and mobile apps.

It is clear that these three programmes of smart city activities differ considerably. It follows that it would be unhelpful to understand the emerging practices and stories told at local level as determined by global corporate discourses or national policies. The 'smart' concept rhetorically co-articulates an array of otherwise heterogeneous and often spatially dispersed projects, programmes of initiatives, promotional documents, and strands of official policy. However, any 'idealised' smart city narrative has become inflected with existing city branding strategies (Valdez et al., 2018). Within this, activities are consciously positioned as drawing on different local enabling conditions, their goals are narrated differently, and they are funded from disparate sources. These examples uphold the contention that "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).

If the fragmentation of this landscape of projects deters a technocratic reading of the local UK smart city, its varied forms nevertheless display certain commonalities which actively align it with the trend towards urban experimentation, as outlined earlier. Two of these commonalities are outlined below, relating to the fluidity of governance arrangements, and the explicit discourse of experimentation through which activities are promoted. Without asserting that these characteristics apply equally to all UK smart strategies, the current discussion proceeds on the grounded assumption that they typify contemporary national trends.

Governance arrangements

Just as smart city practices differ significantly across the UK, they are not directed by any particular framework of institutional arrangements. Rather, in line with urban experimentation generally, shifting multi-sectoral partnerships are the norm. In Bristol, the council takes the lead, but is only one actor among many in the city's "well-developed innovation ecosystem" (Connecting Bristol, undated c). The council coordinates the 'Bristol is Open' partnership in collaboration with the University of Bristol, supported by other private, public and charitable organisations, but has a more indirect role in the 'Connecting Bristol' programme, whose activities are typically supervised by social enterprises. Manchester's smart city activities are coordinated by varying combinations of heterogeneous actors alongside the council – most noticeably, the city's universities and large hospitals, local engineering and hi-tech firms, Transport for Greater Manchester, and grass-roots digital organisation Future Everything. In Milton Keynes, the Open University is the dominant actor, working with local private companies and community groups, while the council apparently plays an endorsing and enabling role. What all three cases have in common, then, is the networked nature of their governance: although city councils exert significant influence, they have no overall responsibility for what has emerged.

If the fundamental unit of the smart city is the individual, opportunistic project, overarching strategy appears to be more of an afterthought. Indicatively, Bristol has no single related vision or strategy; Manchester's 'Smarter City' programme promotes activities already taking place or planned; MK:Smart lays out plans for specific activities, but is orchestrated primarily by the locally based Open University, rather than the council. None of these cases, then, displays clear linearity (either narrated or practised) between formal strategies, plans, and activities. Elsewhere in the UK, Glasgow's 'Future City' programme comes closest to this idealised model of planning: the city council implemented the proposals from its 2012 'Future Cities Demonstrator' Feasibility Study (Glasgow City Council, 2012). However, its 'Future City' programme was funded as a discrete project to be completed by 2014; whether these activities will substantially affect Glasgow's statutory strategic policy-making remains unclear.

In all three cities, then, smart city activities operate at the periphery of mainstream institutional policy-making. From the perspective of the current article, however, this peripherality does not diminish their significance, but is rather constitutive of their status as experimental initiatives.

Experimental discursive presentation

Smart city activities in the UK are often promoted through a language of experimentation. In an article on "the UK's smartest city", Bristol's mayor George Ferguson is quoted as asserting that "by working closely with business, with academia and, of course, with citizens, we can learn together in our live urban lab" (Doward, 2014). The Knowle West Media Centre, involved in many of the city's smart activities, describes itself as Bristol's "Living Lab" (KWMC, undated b). The 'Bristol is Open' programme is organised around the idea of "City Experimentation as a Service" (Bristol is Open, undated b). Milton Keynes' submission to the 2012 'Future Cities Demonstrator' competition asserted that "the city is a living urban laboratory" (Milton Keynes Council 2012:3). Its more recent 'MK:Smart' programme (MK:Smart, undated a) includes a 'Citizen Lab' for "engaging the community in innovation-centric

decision-making processes". Both the 'Bristol is Open' and Milton Keynes' Future City programme are publicised as 'test beds' (Bristol is Open, undated c; Milton Keynes Council undated: 4). The promotion of Manchester's 'Corridor' as an 'urban laboratory' has already been documented by Evans and Karvonen (2014) in relation to climate change experimentation; the area also hosts Manchester's University 'Living Lab', aiming to allow different stakeholders to "deploy and monitor new technologies and services in real world settings" (University of Manchester, undated); and the locally-based *Future Everything* organisation runs "year-round digital innovation labs" (Hement, 2011: 10). While a comprehensive analysis of this promotional language exceeds the scope of the current article, the metaphorical domain of the 'laboratory' is clearly an important building block in the discursive storyline woven around the UK smart city.

These linguistic choices may merely describe a conscious attempt to exploit a currently fashionable discursive trend, for the purposes of legitimation (de Jong et al., 2015). More broadly, the meaning of the label 'experiment' may have been diluted through wide use across different social fields (Gross, 2009; Powell and Vasudevan, 2007). And yet there is good reason to consider the work done by 'systematic' patternings of metaphor across different texts within a 'discourse community' (Cameron, 1999; Semino, 2008). As rhetorical devices, metaphors are "deployed to convince listeners or readers by putting a situation in a particular light" (Dryzek, 2005:18), and have ideological force in potentially normalising particular conceptual structures (Chilton and Schäffner, 2002). Metaphors which "do political work" are particularly common in descriptions of technology (Sismondo, 2010: 155), normalising imaginaries and guiding its development over time, and therefore providing "clues to the design intentions of those who use them" (Wyatt, 2004: 244). Accordingly, urban experimental metaphors specifically are significant in the intentionality of their normalisation of "new political spaces" (Bulkeley and Castán Broto, 2013: 361).

Nevertheless, experimental practices cannot be inferred from their rhetorical mobilisation in promotional materials. The case that the practices themselves might be considered as 'experimental' is therefore made in the following section, by outlining certain characteristics which bracket urban experimentation, as exemplified by the UK smart city, with 'scientific' experiments, as theorised by Shapin and Schaffer (2011). As outlined in the Introduction, these characteristics relate to:

- the ideal of replicability;
- the importance of demonstration and consensus-building;
- the reworking of societal spheres;
- contestations over boundaries;
- policing and promotion;
- rhetorical humility.

Experiments old and new

A clear parallel, first, is apparent between the importance of *replicability* in the 17th century experimental ideal (Shapin and Schaffer, 2011), and the hope of learning transferable lessons in

contemporary urban experiments (Evans and Karvonen, 2014). Just as scientific experiments were legitimated through the production of results applicable beyond the laboratory – both in other similarly constructed niches, and in terms of the truths generated about the world – urban experiments are deemed successful if useful lessons can be learnt and applied elsewhere or at a wider scale. To take just one example from those mentioned earlier, the overall goal of Manchester’s Triangulum project is to “*demonstrate, disseminate and replicate* solutions and frameworks for Europe’s future smart cities” (Triangulum, undated).

The ‘demonstrative’ dimensions of early scientific experiments related to the (nominal) publicness of their performance: they were legitimised by witnesses – either *in situ*, or virtually, as the audience of published scientific results (Shapin and Schaffer, 2011:60–65). The truth of generated facts depended on their social acceptance (Garber, 1997); experiments conducted in private were relegated to the realm of speculation or quackery. And yet, as Shapin and Schaffer show, considerable work went into policing the particular – limited – ‘publicness’ of these experiments; and its boundaries were contested. A double parallel with (smart city) urban experimentation is therefore evident. First, great emphasis is placed by smart city practitioners on the need for ‘open innovation’ and ‘open data’ (Barns, 2016): “Being open means we proactively share what we learn with other cities, technology companies, universities and citizens” (Bristol is Open, undated b). In an important sense, smart city activities are *legitimised* through inclusive participation and public awareness; as experiments, they are “supposed to prompt radical social and technical transition by testing out different technologies under a range of conditions in highly visible ways” (Evans, 2011:225). Both scientific and urban experiments, equally, depend for their legitimacy on *consensus* – forged for the former among a well-defined inner circle of experts, but reworked for the latter to refer to a ‘local community’ of multi-sectoral actors.

Second, and relatedly, both types of experiment involve *reworking the boundaries between different societal spheres*. Just as, in Shapin and Schaffer’s account, contestations over the ‘public’ qualities of seventeenth-century scientific experiments were grounded in differing normative frameworks of societal order, urban experiments have been directly “linked to the global processes of the shifting and blurring of public/private authority and the restructuring of the (local) state, but also to the emergence of new forms of institutional innovation emerging through experiments themselves” (Bulkeley and Castán Broto, 2013:373). It should also be noted that in the UK, as elsewhere, the smart city specifically is associated with a series of debates around the challenges which digital technology and ‘big data’ pose to existing norms and regulations of ‘privacy’ (see e.g. Kitchin, 2014; Pasquale, 2015).

If the boundaries of early scientific experimental spaces were contested, it is significant that the spatiality of contemporary urban experimentation is ambiguous in its relative *lack* of boundedness. It is perhaps here where contemporary experiments are most readily defined in opposition to scientific experimentation whereby “The researcher designs the set-up of the experiment and aims to control all relevant aspects of the process, as far as possible separated from the complexity of real-world conditions” (Sengers, Berkhout, et al., 2016: 16). Rather, “For...the new urban ecology and adaptive experimentation, the messiness of place is constitutive of, rather than antithetical to, scientific practice” (Evans, 2011:231). However, the ‘hermetic sealing’ of scientific experimental space was not

inevitable so much as an ideal to be fought for, in order that socially required modes of knowledge might be generated. It is therefore germane to ask what social needs are met through the conscious ‘unbounding’ of the spaces of contemporary urban experiments – still taking place in ‘niches’, but with porous borders.

An understanding of experimental spaces as having not only a concrete location but also an abstract form, as a cultural or social domain (Shapin and Schaffer, 2011:333), may be helpful in this regard. Specifically, the collaborative multi-sectoral approach to smart city experimentation may yield clues to the role played by their porous spatiality. In this, they would seem to be straightforwardly reflective of the more general shift away from top-down ‘government’ to less hierarchical types of networked ‘governance’ (see eg Bellamy and Palumbo, 2009; Gualini, 2010). The widely trumpeted promise that collaborative governance holds the key to resolving urban problems (Mejer and Bolívar, 2016) is central to the significant promotional work around urban experiments, and echoes the “intensity” of work in the 17th century “to publicize experimental spaces as useful” (Shapin and Schaffer, 2011:341).

A final parallel may be drawn with Boyle’s 17th-century scientists whose self-presentation as modest discoverers of ‘facts’ (Shapin and Schaffer, 2011:65–69) belied the ongoing active work put into constructing, regulating and justifying this particular mode of knowledge and the political agenda which it implied. Similarly, the pragmatic rhetoric of urban experimentation is ‘modest’ in its emphasis on allowing solutions to emerge, and encouraging open-ended social learning and innovation, rather than imposing definitive solutions. Indicatively, for example, Bristol has aspired to create an “ecosystem of open-innovation” wherein “citizens and communities are empowered to engage and co-create solutions” (Bristol City Council 2012: 18); Milton Keynes’ flagship ‘OurMK’ programme “is all about helping local people solving problems in their communities” (OurMK, undated); and, rather than foregrounding concrete goals, Manchester’s ‘CityVerve’ project centrally envisions “a Manchester of endless possibilities” (CityVerve, undated).

This type of ‘quasi-evolutionary’ framing (Hegger et al., 2007:730) may be viewed as rhetorically directing attention away from the unevenness of the fields in which experiments are embedded, vulnerable to the “logic of relations of force” (Callon et al., 2009) and hindered when they lack strong institutional or financial backing (Bai et al., 2010). Accordingly, various critical charges are levelled at contemporary policy experiments. Rather than being valenced towards effecting transitions towards more sustainable societal arrangements, they are accused of “reproducing and facilitating the existing neoliberal political agenda” (Evans et al., 2016b: 7), with states of crisis constructed to justify ‘neoliberal experimentation’ in governance and economic approaches (Oosterlynck & González, 2013). For Hoffmann (2011:39), the “market orientation” of experimentation in the field of climate change governance is not suggestive of a radical transformation of incumbent hierarchies, but rather a compromise which “predicates environmental protection on the promotion and maintenance of a liberal economic order” (Bernstein, 2001: 4). As Bulkeley and Castan Broto (2013) observe, urban experiments may be less ‘open-ended’ than first appearances would suggest: in addition to acknowledging their explicit stated ‘purposes’ (Sengers, Berkhout, et al., 2016), we are urged to attend

to the “political economies of experimentation, by whom and on whose behalf they are enacted, through which modes of governance...and to what ends” (Bulkeley and Castán Broto, 2013:367).

There is good reason, then, to critique urban experiments on the basis of their rhetorical false naivety. Two facets of smart city development are particularly at odds with a ‘naïve’ understanding of urban experiments. First, that their desired ‘replicability’ often relates specifically to the desire to develop technology for export. Second, that they sit within a broader context of attempts to ‘standardise’ smart and sustainable urban development (Joss *et al.*, 2015), as reflected in the BSI’s ‘Smart City Standards’ (as mentioned earlier), as well as the United Nations’ 11th Sustainable Development Goal (UN, undated). And yet the localised experimentation characterising the UK smart city might equally be understood as in *tension* with this desire for standardisation. Not only are the results of such experimentation unpredictable, but the project-centered rather than strategy-driven governance approach – as discussed earlier – appears at this stage to have produced a landscape characterised more by ‘atomisation’ (Mattern, 2016) than by homogeneity. Although, then, as Hodson *et al.* (2017:2) observe, “wider processes of global urbanism provide political-economic conditions of possibility for experimentation” (Hodson *et al.*, 2017:2), particular technological or policy solutions are unlikely to be straightforwardly replicable. Rather, their place-specific embedment will depend on the particular socio-technical and discursive ‘regimes’ into which they are intervening, and which may themselves be multiple and variously complimentary or conflicting within individual cities (*ibid*:15).

Thus, the particular terms on which standardisation is encouraged may usefully be challenged, either as constraints on the urban future set by particular powerful actors, or as limited in their applicability to particular places following processes of replication. Such debates may raise pressing questions about the desirability of what results, and whose interests this serves. Focusing overly on ‘top-down’ constraints, however, may obscure another equally important debate. This relates to the tension between an intended policy-driven standardisation of the urban future and the experimentalism through which the smart city is actually being delivered. Relatedly, the following section illustrates a further characteristic shared across UK smart city initiatives: their rhetorical alignment with sustainable development. We argue that the smart city’s experimental charge contradicts this agenda, precisely because the latter implicitly demands that we should *plan* for the long-term future.

Smart-sustainable development?

Attempting to map the thematic content of ‘smart city’ agendas onto the concerns of (urban) ‘sustainable development’ would be a spurious exercise, given both the former’s empirical variety and the latter’s conceptual and practical heterogeneity. Nevertheless, in the three cities discussed here, ‘smart’ is clearly discursively interwoven with ‘green’ or ‘sustainable’. The focus of Bristol’s original Smart City Bristol report (Bristol City Council, 2011), on emissions and transport, was expanded into an overall aim “to create environmentally and socially sustainable jobs and growth” (Bristol City Council, 2012: 1). The ‘Connecting Bristol’ partnership now promotes itself (or Bristol) as “Creative. Smart. Green. Connected.”, piloting the “potential of the latest smart technologies to ensure that Bristol becomes a resilient, sustainable, prosperous, inclusive and livable place” (Connecting Bristol, undated a).

Manchester's Corridor has long been associated with sustainability and low-carbon initiatives (Karvonen and van Heur, 2014). Milton Keynes' submission to a national funding competition in 2012 had the "unambiguous objective...to reduce its carbon footprint with an energy-efficient high-tech knowledge" (Milton Keynes Council, 2012: 3). Meanwhile, the OurMK website invites residents to "Help make Milton Keynes a smarter, greener city" (OurMK, undated).

Several reasons may be proposed why notions of 'smart' are relatively easily overlaid onto existing strategic goals framed by the idea of sustainable urban development. Most obviously, the smart city promises greater efficiency in resource use, echoing the broader tendency for experimental activities to address environment-related goals (Karvonen et al., 2014). Internationally, smart digital technology has updated large-scale 'eco-city' projects, with significant discursive overlap between the two (Caprotti, 2015: 90; de Jong et al., 2015). Simultaneously, it makes a lexical bridge with existing discourses of 'smart growth', related to improving cities' environmental performance and liveability through the avoidance of sprawl, and the desire to attract a 'smart' (ie well-educated) workforce in constructing a suitably entrepreneurial and 'creative' city (Kitchin, 2015). Meanwhile, as explicitly advocated by the UK's Local Government Association (LGA, 2015), smart technologies offer economic efficiencies for city administrators. Thus, the UK smart city is underpinned by an international discursive storyline casting cities as obliged both to become more socially and environmentally sustainable, and to compete economically. It responds to a diagnosis of "resource pressures brought on by rapid urbanization and an aging population, the effects of anthropogenic global climate change, and the twinned pressure of fiscal austerity and inter-urban competition" (White, 2016: 577).

The recognisability of this storyline may invite critiques of the smart city as reflecting a broader trend towards neoliberal and post-political urban policy-making (Swyngedouw, 2009), or as problematically illustrative of sustainable development's conceptual 'malleability' (Kates et al., 2005). A much wider set of critical debates around sustainable development should also be acknowledged, ranging from those rooted in challenges to the broader 'developmental' project (Escobar, 1994), to recent problematisations of its implications for urban space specifically, with reference to the United Nation's 2016 Sustainable Development Goals (Caprotti et al., 2017). The present article, however, does not aim to review, or intervene directly into, such debates. Rather, it is merely noted that the UK smart city has been consciously intertwined into sustainable development's discursive umbrella. In its rhetorical presentation, it declares the ambition to help shape a more economically, socially and environmentally viable urban future.

Martin et al. (2018) are sceptical about the contemporary smart city's ability to achieve this ambition. They find little empirical evidence to counter the idea "that smart city initiatives in practice reinforce the focus on delivering unsustainable forms of economic growth and consumerist cultures, while neglecting social equity and environmental protection" (8). This is a strong criticism, but we argue that it is at least compatible with an understanding of the smart city as urban experiment – in that urban experiments diverge from the ambition of securing the *future*. Since refuting the desirability of a 'sustainable' global future would seem eccentric, sustainable development positions us as *responsible* towards this future; state actors claiming to be guided by its goals are asserting their own obligation to govern in ways

informed by an intention to shape a viable future for humankind. Rather than being a “spontaneous social product”, then, sustainable development implies “goal-directed intervention by governments and other actors” (Meadowcroft, 2007:302).

The smart city, however, has at best an ambivalent relationship with the very strongly normative project of planning the future. This ambivalence is illustrated particularly clearly with reference to the Big Data-driven ‘control room’. Often treated as the smart city’s emblematic heart (Halpern et al., 2013; Kitchin, 2015), the control room has been interpreted as an expression of high modernism (Greenfield, 2013; Picon, 2015). In the UK specifically, the control room has tangible importance most obviously in the ‘Operations Centres’ managing traffic and public safety in Glasgow and Bristol. It also finds an echo in Milton Keynes’ operational ‘Data Hub’, and the ‘Manchester-i Observatory’, proposed (though not implemented) in the high-profile 2012 ‘Future Cities Demonstrator’ funding competition (Technology Strategy Board, 2013). Critical commentaries have interpreted the implicit goal of knowing the city in ‘real-time’ as naïvely positivistic (Kitchin, 2014a), and the shift of control “from the city hall to the new information-stacked command centre” (Joss, 2015:257) as a regressive return to a “more positivist, rational planning mode” (Joss, 2016:7). Nevertheless, the smart city control room may more satisfactorily be understood not so much as a technocratic threat but as *challenging* the possibility of ‘rational’ planning. Its promise to open up new opportunities for visualising and apprehending the city (Batty, 2016) may obscure the significance of a new emphasis on “understanding of how urban systems function in the short term” and reinforcing our capabilities only to respond to “very short-term crises” (Batty, 2013: 277). In placing its faith in big data, the control room sits uncomfortably with planning as a representational technology of governance which retains “quintessentially modernist” (Karadimitriou, 2010: 425) underpinnings. In promising to shortcut the “abstract and reductionist constructions of data of the past” (Chandler, 2015: 836), big data holds out the promise of “cities that understand themselves and thereby govern themselves” (ibid: 844) more effectively than through the cumbersome and costly institutional mechanisms through which the city has traditionally been ‘known’ (Joss, 2015: 257).

It is reductive, particularly in a study of the emerging ‘actually existing’ smart city, to treat the control room as representing its essential feature. And yet it is the control room – in spite of its relative infrastructural fixity – that most immediately alerts us to the smart city’s epistemological orientation towards ongoing adaptive learning, rather than proactive planning based on long-term normative envisioning. The smart city *qua* experiment is ontologically framed by – and performatively reproduces – a narrative of global complexity and uncertainty. In place of hubristic modernist linearity, it proposes a more tentative, pragmatist, iterative process of discovery. Instead of exhibiting the ‘closure’ of a plan (Allmendinger, 2002:180), it claims to be constituted through emergent practice. Its ‘laboratories’ are legitimised precisely through their embedment within society and a logic of inductive discovery, in contradistinction to the clumsiness of representations generated by the bounded scientific laboratory or the political institutions of democratic modernity (Latour, 1993; Callon et al., 2009). The contemporary experimental tendency, exemplified by the unfolding UK smart city, thereby responds to a widespread disillusionment with liberal government and public institutions (Berlant, 2011; Swain and Tait, 2007), in an age when we are “no longer so sure that traditional characterizations of how science proceeds

adequately describe its reality, just as we have come increasingly to doubt whether liberal rhetoric corresponds to the real nature of the society in which we now live” (Shapin and Schaffer, 2011:343).

Conclusions: Smart City as Anti-Planning

This article has aimed to shift attention away from interpretations of the smart city as a technocratic threat, and onto its disruptive orientation towards established normative ‘technologies of planning’. To this end, it has focused on the (rhetorical and practical) experimental aspects of the UK smart city. The argument departs from other commentaries on urban experimentation, however, since it has not begun by distinguishing this contemporary phenomenon from idealised modes of ‘scientific’ experiment. Instead, it has mobilised a transhistorical understanding of experimentation as an intended process of societal reordering. From this perspective, the experimental qualities of the smart city sit less comfortably alongside goal-driven visions of the urban future than their rhetorical presentation suggests. Instead, they issue a challenge to the very ambition of ‘planning’ the urban future.

Our claim is not that all experimentation at the margins of institutional policies and processes necessarily leads to unwelcome outcomes, or straightforwardly undermines structures of governance. Far from it: innovative experimentation has the potential to inform constructive adjustments to existing institutions at times of social and technological change. Experiments may, furthermore, be variously goal-driven or open-ended, and the force of their wider influence variously constrained. Equally, our argument is not intended as a ‘narrative of loss’ mourning the demise of an imaginary golden age of modernist planning in the UK. Indeed, studying the contemporary smart city may usefully illuminate the ‘messy’ nature of policy-making in the past. Further research into its dynamic relationship with planning may serve to remind us that institutions continually evolve as sedimentations of changing ‘human conventions’ (Moroni, 2010).

More precisely, the notion of ‘anti-planning’ here questions the assumption that smart city experimentation is unproblematically aligned with the ambition of intentionally shaping a more equitable future. Insofar as the smart city exemplifies an experimentalist ‘new spirit’ (Kimbell and Bailey, 2017) of policy-making, its appeal no doubt partly lies in its optimism, as a response to Luhmann’s diagnosis of the postmodern “desolate state” of planning (Luhmann, 1997: 41, cited in van Assche and Verschraegen, 2008: 264). In the face of a growing understanding of the world as complex, uncertain, and non-linear (Rosenau, 2000; Chandler, 2014; Voß et al., 2007), it is precisely the tentative, experimental modality of the smart city that has an appealing logic for policy-makers unable to “abandon the notion of steering and to let the future come as it comes” (Luhmann, 1997: 41). In more prosaic terms, ongoing budget cuts faced by UK local authorities preclude the possibility of long-term funding commitments to significant transformations of urban space. And yet, in valorising pragmatic learning over predefined long-term outcomes, smart city experimentation performatively excludes a structural understanding of social and environmental problems. Our central claim is that this trend potentially serves to catalyse a sedimentation of norms of pragmatic ‘efficiency’ and constant ‘adaptive learning’ within institutional processes once more explicitly guided by longer-term envisioning of the ‘public good’ and the aspiration of mitigating public bads.

This is not to imply that the smart city concept *per se* will necessarily be of lasting interest to UK policy-makers. More importantly, ongoing attention might usefully be paid to the collective force of the experimental trend which it exemplifies, and the work this does in reordering society. Furthermore, no strong claims are made here about the smart city's experimental charge in contexts outside the UK: this article has deliberately avoided making universal claims about the smart city based on global discourse, and began instead by considering its emergent heterogeneity in local contexts. And if city-specific smart initiatives are characterised by their variety, so too are the local (and national) governance processes through which – or in spite of which – they emerge. Attempts to develop generalised theories about the smart city's relationship with planning are likely to be undermined by the multiplicity of planning practices around the world (Alexander, 2015), context-specific implications of entrenched institutional structures, and differing levels of governmental capacity (Watson, 2016). We nevertheless urge researchers to consider the relevance or otherwise of our argument to other settings, particularly through more ethnographic work into implemented smart city activities, exploring not only their material effects on urban space and social relations, but also their concrete effects on incumbent local practices of urban planning.

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REFERENCES

- Alexander, E.R. (2015) There is no planning—only planning practices: Notes for spatial planning theories. *Planning Theory*, 15(1): 91-103. <https://doi.org/10.1177/1473095215594617>
- Allmendinger P (2002) *Planning Theory*. Basingstoke: Palgrave Macmillan.
- Ansell CK and Bartenberger M (2016) Varieties of experimentalism. *Ecological Economics* 130: 64–73.
- Bai X, Roberts B and Chen J (2010) Urban sustainability experiments in Asia: patterns and pathways. *Environmental Science & Policy* 13(4): 312-325.
- Barns S (2016) Mine your data: open data, digital strategies and entrepreneurial governance by code. *Urban Geography* 37(4): 554–571.
- Batty M (2013) Big data, smart cities and city planning. *Dialogues in Human Geography* 3(3): 274–279.
- Batty M (2016) Editorial: Big Data, Cities and Herodotus. *Built Environment* 42(3): 317-320.
- Bellamy R and Palumbo A (eds) (2009) *From Government to Governance*. London: Routledge.
- Bernstein S (2001) *The Compromise of Liberal Environmentalism*. New York: Columbia University Press
- Berlant L (2011) *Cruel Optimism*. Durham: Duke University Press.
- Bristol City Council (2011) *Smart City Bristol*. Presentation. Available at: <https://www.slideshare.net/Bristolcc/bristol-smart-city-report-7579696> (accessed 12 March 2017).
- Bristol City Council (2012) *Connect Bristol Feasibility Study*. Bristol, Bristol City Council. Available at: <https://connect.innovateuk.org/documents/3130726/6091879/Feasibility+Study++Bristol+City+Council.pdf/4269233f-cd8b-47da-9f0b-58a27294a684> (accessed 12 May 2016).
- Bristol is Open (undated a). *Overview*. Available at: <https://www.bristolisopen.com/overview/> (accessed 12 December 2016).
- Bristol is Open (undated b) *About*. Available at: <http://www.bristolisopen.com/about/> (accessed 12 December 2016).
- Bristol is Open (undated c) *Bristol is Open – Introduction*. Video. Available at: <http://www.bristolisopen.com/> (accessed 12 December 2016).
- BSI (undated) Smart Cities Standards and Publications. Available at: <https://www.bsigroup.com/en-GB/smart-cities/Smart-Cities-Standards-and-Publication/> (accessed 12 December 2016).
- Bulkeley H and Castán Broto V (2013) Government by experiment? Global cities and the governing of climate change. *Transactions of the Institute of British Geographers* 38(3): 361–375.
- Callon M, Lascoumes P and Barthe Y (2009) *Acting in an Uncertain World: An Essay on Technical Democracy*. Cambridge, MA: MIT Press.

Cameron L (1999) Operationalising 'metaphor' for applied linguistic research. In: Cameron L and Low G (eds) *Researching and Applying Metaphor*. Cambridge: Cambridge University Press, pp.3–28.

Caprotti F (2015) *Eco-Cities and the Transition to Low Carbon Economies*. Basingstoke: Palgrave Macmillan.

Caprotti F and Cowley R (2017) Interrogating Urban Experiments. *Urban Geography*. 38(9): 1441-1450.

Caprotti F, Cowley R, Datta A, Castán Broto V, Gao E, Georgeson L, Herrick C, Odendaal N and Joss S (2017) The New Urban Agenda: key opportunities and challenges for policy and practice. *Urban Research & Practice* 10(3): 367-378.

Caprotti F, Cowley R, Flynn A, Joss S. and Yu L (2016) *Smart-Eco Cities in the UK: Trends and City Profiles 2016*. Exeter: University of Exeter.

Castán Broto V (2017) Urban Governance and the Politics of Climate change. *World Development* 93: 1–15.

Chandler D (2015) A World without Causation: Big Data and the Coming of Age of Posthumanism. *Millennium: Journal of International Studies* 43(3): 833–851.

Chandler D (2014) Beyond neoliberalism: resilience, the new art of governing complexity. *Resilience* 2(1): 47–63.

Chilton P and Schäffner C (2002). Introduction: themes and principles in the analysis of political discourse. In: Chilton P and Schäffner C (eds) *Politics and Talk and Text: Analytic Approaches to Political Discourse*. Amsterdam: John Benjamin, pp.1–41.

CityVerve (undated). *About the Programme*. Available at: <http://www.cityverve.org.uk/what-is-cityverve/> (accessed 23 Feb 2018).

Connecting Bristol (undated a) *Inclusion*. Available at: <http://www.connectingbristol.org/category/inclusion/> (accessed 10 February 2018).

Connecting Bristol (undated b) *About*. Available at: <http://www.connectingbristol.org/about/> (accessed 10 February 2018).

Connecting Bristol (undated b) *Innovation*. Available at: <http://www.connectingbristol.org/category/innovation/> (accessed 10 February 2018).

Cowley R, Joss S and Dayot Y (2018) The smart city and its publics: insights from across six UK cities. *Urban Research and Practice* 11(1): 53-77.

Curtis J (2015) Bristol IoT project turns whole city into research lab. *CloudPro*, 5 Feb. Available at: <http://www.cloudpro.co.uk/saas/business-intelligence/4814/bristol-iot-project-turns-whole-city-into-research-lab> (accessed 26 March 2017).

de Jong M, Joss S, Schraven D, Zhan C and Weijnen M (2015) Sustainable–smart–resilient–low carbon–eco–knowledge cities; making sense of a multitude of concepts promoting sustainable urbanization. *Journal of Cleaner Production* 109: 25–38.

Dorstewitz P (2014) Planning and Experimental Knowledge Production: Zeche Zollverein as an Urban Laboratory. *International Journal of Urban and Regional Research* 38(2): 431–449.

Doward J (2014) Networked and super fast: welcome to Bristol, the UK's smartest city. *The Guardian*, 16 November 2014.

Escobar A (1994) *Encountering Development: The Making and Unmaking of the Third World*. Princeton, NJ: Princeton University Press

European Parliament (2014) *Mapping Smart Cities in the EU*. IP/A/ITRE/ST/2013B02. Available at: <http://www.smartcities.at/assets/Publikationen/Weitere-Publikationen-zum-Thema/mappingsmartcities.pdf> (accessed 14 June 2016).

Evans J (2016) Trials and Tribulations: Problematizing the City through/as Urban Experimentation. *Geography Compass* 10(10): 429–443.

Evans J and Karvonen A (2014). 'Give Me a Laboratory and I Will Lower Your Carbon Footprint!' — Urban Laboratories and the Governance of Low-Carbon Futures. *International Journal of Urban and Regional Research* 38(2): 413–430.

Evans J, Karvonen A and Raven R (eds) (2016a) *The Experimental City*. Abingdon: Routledge.

Evans J, Karvonen A and Raven R (2016b) The experimental city: New modes and prospects of urban transformation. In: Evans J, Karvonen A and Raven R (eds) *The Experimental City*. London: Routledge, pp.1–12.

Evans JP (2011) Resilience, ecology and adaptation in the experimental city. *Transactions of the Institute of British Geographers* 36(2): 223–237.

Foucault M (1991) *Discipline and punish: The birth of the prison*. London: Penguin

Garber D (1997) Experiment, Community, and the Constitution of Nature in the Seventeenth Century. In: Earman J and Norton JD (eds) *The Cosmos of Science: Essays of Exploration*. Pittsburgh, PA: University of Pittsburgh Press, pp.24–54.

Gieryn TF (2006) City as Truth-Spot: Laboratories and Field-Sites in Urban Studies. *Social Studies of Science* 36(1): 5–38.

Glasgow City Council (2012) *Glasgow City Management System*. Available at: <https://connect.innovateuk.org/documents/3130726/3794125/Feasibility+Study+-+Glasgow+City+Council.pdf> (accessed 14 June 2016).

Gray T (2005) Theorising about participatory fisheries governance. In: Gray T (ed) *Participation in Fisheries Governance*. Dordrecht: Springer, pp. 1–18.

- Greenfield A (2013) *Against the smart city*. New York: Do Projects.
- Griffin L (2010) Editorial: Governance Innovation for Sustainability: Exploring the Tensions and Dilemmas. *Environmental Policy and Governance* 20(6): 365–369.
- Gross M (2009) Collaborative experiments: Jane Addams, Hull House and experimental social work. *Social Science Information* 48(1): 81–95.
- Gualini E (2010) Governance, Space and Politics: Exploring the Governmentality of Planning. In: Hillier J and Healey P (eds) *The Ashgate Research Companion to Planning Theory: Conceptual Challenges for Spatial Planning*. Farnham: Ashgate, pp.57–85.
- Halpern O, LeCavalier J, Calvillo N. and Pietsch W (2013) Test-Bed Urbanism. *Public Culture* 25(2): 272–306.
- Healey P (2006) *Urban Complexity and Spatial Strategies: Towards a Relational Planning for Our Times*. London: Routledge.
- Hegger DLT, Van Vliet J and Van Vliet BJM (2007) Niche Management and its Contribution to Regime Change: The Case of Innovation in Sanitation. *Technology Analysis and Strategic Management* 19(6): 729–746.
- Hemment D (2011) Innovation Labs. In Hemment D (ed) *The FutureEverything Manual*. Manchester: FutureEverything, pp.10-11.
- Hodson M, Geels FW & McMeekin A. (2017) Reconfiguring Urban Sustainability Transitions, Analysing Multiplicity. *Sustainability* 9(2): 299.
- Hoffmann MJ (2011) *Climate Governance at the Crossroads: Experimenting with a Global Response after Kyoto*. Oxford: Oxford University Press.
- Jasanoff S (2015) Future Imperfect: Science, Technology, and the Imaginations of Modernity. In: Jasanoff S and Kim S-H (eds) *Dreamscapes of Modernity: Sociotechnical Imaginaries and the Fabrication of Power*. Chicago, IL: Chicago University Press, pp.1–33.
- Joss S (2015) *Sustainable Cities: Governing for Urban Innovation*. London: Palgrave Macmillan.
- Joss S (2016) 'Smart City': A Regressive Agenda? University of Westminster. Available at: <https://www.westminster.ac.uk/file/71546/download> (accessed 15 April 2018).
- Joss S, Cowley R, de Jong M, Müller B, Park B-S, Rees W, Roseland M and Rydin Y (2015) *Tomorrow's City Today: Prospects for Standardising Sustainable Urban Development*. London: University of Westminster International Eco-Cities Initiative.
- Karadimitriou N (2010) Cybernetic Spatial Planning: Steering, Managing or Just Letting Go? In: Hillier J and Healey P (eds) *The Ashgate Research Companion to Planning Theory: Conceptual Challenges for Spatial Planning*. Farnham: Ashgate, pp.425–446.

- Karvonen A and van Heur B (2014) Urban Laboratories: Experiments in Reworking Cities. *International Journal of Urban and Regional Research* 38(2): 379–392.
- Kates RW, Parris TM and Leiserowitz AA (2005) What is Sustainable Development? Goals, Indicators, Values, and Practice. *Environment: Science and Policy for Sustainable Development* 47(3): 8–21.
- Kimbell L and Bailey J (2017) Prototyping and the new spirit of policy-making. *CoDesign* 13(3): 214–226.
- Kitchin R (2014) The real-time city? Big data and smart urbanism. *GeoJournal* 79(1): 1–14.
- Kitchin R (2015). Making sense of smart cities: addressing present shortcomings. *Cambridge Journal of Regions, Economy and Society* 8(1): 131–136.
- Kullman K (2013) Geographies of Experiment/Experimental Geographies: A Rough Guide. *Geography Compass* 7(12): 879–894.
- KWMC (undated a) *The Bristol Approach to Citizen Sensing*. Available at: <http://kwmc.org.uk/wp-content/uploads/2015/12/Bristol-Approach-Citizen-Sensing-A4.pdf> (accessed 3 May 2016).
- KWMC (undated b) *Bristol Living Lab*. Available at: <http://kwmc.org.uk/projects/bristolivinglab/> (accessed 3 May 2016).
- Latour B (1993) *We Have Never Been Modern*. Cambridge, MA: Harvard University Press.
- LGA (2015) *Transforming local public services using technology and digital tools and approaches*. Available at: http://www.local.gov.uk/productivity/-/journal_content/56/10180/6357119/ARTICLE (accessed 26 April 2016).
- Luhmann N (1997) Limits of Steering. *Theory, Culture & Society* 14(1): 41–57.
- Manchester City Council (2013) *Manchester Future City: Feasibility Report to Manchester City Council*. Available at: <https://connect.innovateuk.org/documents/3130726/3794125/Feasibility+Study+-+Manchester+City+Council.pdf/f1a7d5eb-6651-471a-b9f8-7f9e0f3ec4fa> (accessed 10 February 2016).
- Manchester City Council (undated a) *Smarter City*. Available at: <http://www.manchester.gov.uk/smartercity> (accessed 20 January 2018).
- Manchester City Council (undated b) *EcoHome Lab*. Available at: http://www.manchester.gov.uk/site/custom_scripts/smarter_city/case_studies.php?id=138639 (accessed 20 January 2018).
- Markides, C (2006) Disruptive Innovation: In Need of Better Theory. *The Journal of Product Innovation Management*, 23(1): 19–25.
- Martin CJ, Evans J and Karvonen E (2018) Smart and Sustainable? Five tensions in the visions and practices of the smart-sustainable city in Europe and North America. *Technological Forecasting and Social Change*. Epub ahead of print 15 February 2018. DOI: 10.1016/j.techfore.2018.01.005

Mattern S (2016) Interfacing urban intelligence. In: Kitchin R and Perng S-Y (eds) *Code and the City*. London: Routledge, pp.49–60.

Meijer A and Bolívar MPR (2016) Governing the Smart City: A Review of the Literature on Smart Urban Governance. *International Review of Administrative Sciences*, 82(2): 392-408.

Milton Keynes Council (2012) *Future-Ready MK*. Available at: <https://connect.innovateuk.org/documents/3130726/3794125/Feasibility+Study+-+Milton+Keynes+Council.pdf/3ec3cf6d-3445-43e4-a11d-5db9b67f0616> (accessed 10 February 2016).

Milton Keynes Council (undated) *Milton Keynes Future City Programme*. Available at: <http://milton-keynes.cmis.uk.com/milton-keynes/Document.ashx?czJKcaeAi5tUFL1DTL2UE4zNRBcoShgo=URPrSMWuvbnM%2BQDM4jYE0g1P6HNk%2FqvzqIRl%2Fmiw0Jkr5IXH3ZvTZw%3D%3D&rUzwrPp%2BZ3zd4E7Ikn8Lyw%3D%3D=pwRE6AGJFLDNIh225F5QMaQWctPHwdhUfCZ%2FLUQzgA2uL5jNRG4jdQ%3D%3D&mCTIbCubSFFxsDGW9IXnlg%3D%3D=hFflUdN3100%3D&kCx1AnS9%2FpWZQ40DXFvdEw%3D%3D=hFflUdN3100%3D&uJovDxwdjMPoYv%2BAJvYtyA%3D%3D=ctNJff55vVA%3D&FgPIIEJYlotS%2BYGoBi5olA%3D%3D=NhdURQburHA%3D&d9Qjj0ag1Pd993jsyOJqFvmyB7X0CSQK=ctNJff55vVA%3D&WGewmoAfeNR9xqBux0r1Q8Za60lavYmz=ctNJff55vVA%3D&WGewmoAfeNQ16B2MHuCPMRKZMwaG1PaO=ctNJff55vVA%3D> (accessed 7 April 2016).

MK:Smart (undated a) *About*. Available at: <http://www.mksmart.org/about/> (accessed 10 October 2016).

MK:Smart (undated b) *Citizens*. Available at: <http://www.mksmart.org/citizens/> (accessed 10 October 2016).

Moroni, S. (2010). An evolutionary theory of institutions and a dynamic approach to reform. *Planning Theory*, 9(4): 275-297.

Muniesa F and Callon M (2007) Economic Experiments and the Construction of Markets. In: MacKenzie D, Muniesa F, and Siu L (eds) *Do Economists Make Markets? On the Performativity of Economics*. Woodstock: Princeton University Press, pp.163–189.

Oosterlynck S and González S (2013) ‘Don’t Waste a Crisis’: Opening up the City Yet Again for Neoliberal Experimentation. *International Journal of Urban and Regional Research*, 37(3): 1075–1082.

OurMK (undated) *Do you have an idea about how to improve your community?* Available at: <https://ourmk.org/> (accessed 10 October 2016).

Pasquale F (2015) *The Black Box Society: The Secret Algorithms That Control Money and Information*. Cambridge, MA: Harvard University Press.

Picon A (2015) *Smart Cities: A Spatialised Intelligence*. Chichester: John Wiley & Sons.

Powell RC and Vasudevan A (2007) Geographies of Experiment. *Environment and Planning A* 39(8): 1790–1793.

Rheinberger H-J (ed) (2006) The shape of experiment. Introduction in *The Shape of Experiment*. Berlin: Max Planck Institute for the History of Science.

Rosenau JN (2000) Change, Complexity, and Governance in a Globalizing Space. In: Pierre J (ed) *Debating Governance: Authority, Steering and Democracy*. Oxford: OUP, pp.167–200.

Semino E (2008) *Metaphor in Discourse*. Cambridge: Cambridge University Press.

Sengers F, Berkhout F, Wieczorek AJ and Raven R (2016) Experimenting in the city: Unpacking notions of experimentation for sustainability. In: Evans J, Karvonen A and Raven R (eds) *The Experimental City*. London: Routledge, pp.15–31.

Sengers F, Wieczorek AJ and Raven R (2016) Experimenting for sustainability transitions: A systematic literature review. *Technological Forecasting and Social Change*. Epub ahead of print 17 September 2016. DOI: 10.1016/j.techfore.2016.08.031.

Shapin S and Schaffer S (2011) *Leviathan and the Air-Pump: Hobbes, Boyle, and the Experimental Life*. Princeton, NJ: Princeton University Press.

Shelton T, Zook M. and Wiig, A (2015) The ‘actually existing smart city’. *Cambridge Journal of Regions, Economy and Society* 8(1): 13–25.

Sismondo S (2010) *An Introduction to Science and Technology Studies*. Oxford: Wiley-Blackwell.

Söderström O, Paasche T and Klauser F (2014) Smart cities as corporate storytelling. *City: analysis of urban trends, culture, theory, policy, action* 18(3): 307–320.

Stead D (2016) Key research themes on governance and sustainable urban mobility. *International Journal of Sustainable Transportation* 10(1): 40–48.

Swain C and Tait M (2007). The Crisis of Trust and Planning. *Planning Theory & Practice* 8(2): 229–247.

Swyngedouw E (2009) The Antinomies of the Post-Political City: In Search of a Democratic Politics of Environmental Production. *International Journal of Urban and Regional Research* 33(3): 601-620.

Technology Strategy Board (2013) *Future Cities Demonstrator Competition: Feasibility Studies Interim Report*. Available at: <https://connect.innovateuk.org/web/future-cities-special-interest-group/feasibility-studies> (accessed 20 September 2017).

Torrens J, Johnstone P and Schot J (2018) Unpacking the Formation of Favourable Environments for Urban Experimentation: The Case of the Bristol Energy Scene. *Sustainability* 10(3): 879.

Triangulum (undated) *Project*. Available at: <http://triangulum-project.eu/index.php/project/> (accessed 10 October 2016).

UK Government (2015) *Manchester wins £10m prize to become world leader in ‘smart city’ technology*. Press Release, 3 Dec. Available at: <https://www.gov.uk/government/news/manchester-wins-10m-prize-to-become-world-leader-in-smart-city-technology> (accessed 10 October 2016).

UN (undated). *Sustainable Development Goal 11*. Available at: <https://sustainabledevelopment.un.org/sdg11> (accessed 12 February 2018).

University of Manchester (undated) *Welcome to the University Living Lab!* Available at: <http://universitylivinglab.org/> (accessed 10 October 2016).

Valdez A-M, Cook M and Potter S (2018) Roadmaps to utopia: Tales of the Smart City. *Urban Studies*. Epub ahead of print 12 February 2018. DOI: DOI: 10.1177/0042098017747857

van Assche K and Verschraegen G (2008) The Limits of Planning: Niklas Luhmann's Systems Theory and the Analysis of Planning and Planning Ambitions. *Planning Theory* 7(3): 263–283.

Voß J-P, Newig J, Kastens B, Monstadt J and Nölting B (2007) Steering for Sustainable Development: a Typology of Problems and Strategies with respect to Ambivalence, Uncertainty and Distributed Power. *Journal of Environmental Policy & Planning* 9(3-4): 193–212.

Watson, V. (2016) Locating planning in the New Urban Agenda of the urban sustainable development goals. *Planning Theory*, 15(4) 435–448

White JM (2016) Anticipatory Logics of the Smart City's Global Imaginary. *Urban Geography* 37(4): 572–589.

Williams J (2016) Can low carbon city experiments transform the development regime? *Futures* 77: 80–96.

Wilson S (2015) *Bristol as a smart green city*. Presentation. Bristol is Open. Available at: http://cor.europa.eu/en/news/Documents/Presentation_Bristol_as_a_Smart_Green_City.pdf (accessed 25 July 2017)

Wyatt S (2004) Danger! Metaphors at Work in Economics, Geophysiology, and the Internet. *Science, Technology, & Human Values* 29(2): 242–261.