Computing the City

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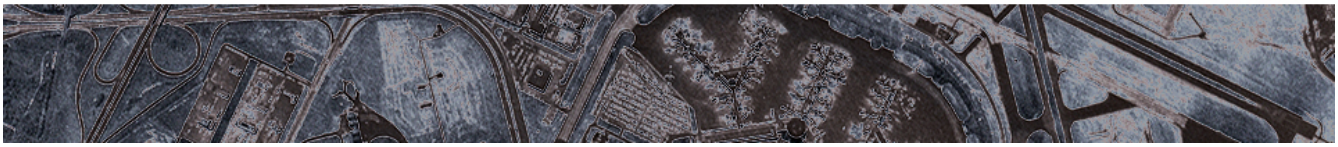

Issue 29 Computing the City

FCJ-212 Editorial

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Ubiquitous computing and the Internet of Things are often referred to as prime examples not only of new modes of computing, but of a new paradigm of mediation itself. If Lewis Mumford could already ascribe key characteristics of media – such as storage and transmission – to the city, so the city could in itself be understood as a medium (see Kittler, 1996), then nonetheless something changes considerably once 'the city itself is turning into a constellation of computers', as Michael Batty noted around twenty years ago (1997: 155). Today the city is indeed awash with distributed and networked computation, and many forms of knowledge and practice not only in architecture and urban planning are turning the city into a subject of computational practices while equipping it with computational capacities. Software codes city space and thereby allows for the co-production of its spatiality; more and more space in the city is reliant on code, producing 'code/space' wherein a space simply does not function without software (Kitchin and Dodge, 2011). This themed issue on 'Computing the City', which emerges from a workshop with the same title held at the Centre for Digital Cultures at Leuphana University Lüneburg in 2014, focuses specifically on the development of urban ubiquitous computing, its status as media infrastructure, its complicity with logistics, as well as its contingent histories and virtual futures. The approach to computing the city taken here questions the accustomed self-description of a mediated society as a completely new infrastructure of living and dwelling. This is not yet another themed issue on the 'smart city' – as we will see below; a consideration of computing the city far exceeds the ways in which the smart city as discourse and project seeks to capture our imaginaries of future technological cities.

The 'smart city' is promoted as the primary site of the materialisation of ubiquitous computing and the Internet of Things: the integration of computational systems with architectural design is supposed to turn inefficient urban settings into smart cities that manifest as the penultimate value-extraction machines (Goodspeed, 2015). In their essay for this issue that focuses on the smart city projects of Songdo in South Korea and Masdar in Abu Dhabi, Orit Halpern and Gökçe Günel demonstrate how the infrastructural imagination of the smart city is tied to neoliberal capital. Marked by speculation, demo-ing and prototyping,

the smart city appears as a prime example of how neoliberal capital proposes to deal with crisis and catastrophe. In this context, human life becomes an experiment for technological futures. Computational 'smartness', and the speculation based on simulation and prediction it affords, are presented as ways of dealing with uncertainty which here is reduced to risk, much like in financial markets dealing in futures. The 'absolute hopefulness' that the smart city exudes is built on the creativity and entrepreneurship it demands of its inhabitants, while the machines of logistics and finance – key complements of smartness in the city – keep extracting value. The smart city needs to make no excuses for its failures: it is always only preliminary, failures are part of its experimental character, yet nonetheless it remains infinitely replicable; a model for the coding of urban space around the globe.

Logistics is key here; smart cities are always already logistical cities, not only in the ways in which smart cities like Songdo always require a logistical complement like Incheon (see Halpern and Günel in this issue), but also in the way they rework and extend the model of the 'logistics city' such as Dubai Logistics City (see Cowen, 2014: 163ff.). The connection between ubiquitous computing and logistical cities highlights how smart cities both make possible and are thoroughly conditioned by logistics. Since the invention of the calendar, clock and tower, as explored by John Durham Peters (2013), logistical media not only pervade the city; rather, the infrastructures they make up also connect cities and thereby constitute the logistical and infrastructural networks in and between cities (Rossiter, 2016: 26ff.). In order to understand what Mike Crang and Stephen Graham call the 'embedding of computing into the background environment of cities' (2007: 790), we need to conceptualise technology or media not as single devices at the end of the line, not as *the* computer or *the* television, but as infrastructures of mediation. Smart cities are oddly part of these logistical networks in that they are not only deeply permeated by logistical media, but even spread their own logics in a protocological fashion as one smart city serves as blueprint for another, further enabling and reproducing logistical networks through infrastructures.

Yet it is only in green site developments, such as Songdo, that the logistical city and its digital foundations are built from scratch. Elsewhere, such projects are confronted with the history, sociality, materiality and mediality of existing cities in all their complexity and ambivalence. Making a city 'smart' requires a lot more than subjecting it to protocol or code and digitising its processes. 'Code/spaces are relational, emergent, and peopled', as Kitchin and Dodge argue (2011: 75), so that computing the city is always a complex and contextual endeavour. As Halpern and Günel show, there is much more at play than merely reproducing a model or imposing computation: something that Shannon Mattern (2016) calls the academy-industry-government complex makes the city ready for smartness by rebuilding it. In his exploratory ethnographic engagement of smart cities in India, Sandeep Mertia shows how in the absence of an overarching complex for smart cities, the socio-technical imaginaries of the smart city and big data still produce a perceived shift in the epistemic and material basis of urbanism. Mertia traces this shift in five vignettes: the emergence of a 'new' image of the city with the rise of Google Maps alongside GIS; a new practice of frantic data collection that is lacking in experts; a focus on open data bringing forth new civic data scientists; a playful development of apps in the city to deal with all sorts of social problems; and finally, a transformed political analysis focused on programmatic marketing and sentiment analysis, among other things blurring the line between citizen, user, consumer and voter. As a researcher entangled in these configurations, Mertia calls for a 'meta-analytics' of data that enrols ethnographic work in exploring the material and social aspects of data's work in the smart city.

Where the smart city expands, is duplicated and traded in a protocological fashion, logistical infrastructure

connects the smart cities in an intelligent web that only knows its own protocological rules and limits. Logistics reveals the logic of smart cities as that of trade and circulation: of data, things and people. In his essay for this issue Ned Rossiter expands on his previous work concerned with logistics (2016) and shifts focus to the kinds of infrastructural media that make possible contemporary smart urbanism. Rossiter sees data centres as part of the infrastructural condition of smart cities, since much of the computational capacity required for (cloud) computing the city resides precisely in these data centres, which follow a geography decoupled from urbanism and focused more on energy and environment. The data centre highlights geopolitical as much as technical considerations. Rossiter finds data centres at the heart of the geopolitics of data-driven, algorithmic capitalism; an approach that produces a sovereign territoriality separated from the state and places notions of geography – such as that of 'Asia' – into question. The infrastructural power produced by data centres Rossiter terms, with Easterling (2014), 'extrastatecraft', and it clearly complements the kinds of infrastructural powers the smart city itself seeks to unfold.

What are, in this wider context, the operational logics of the infrastructures thereby instated? Pervaded by visible and invisible networks, the city becomes a playground for global corporations to experiment with technologies of surveillance, big data and endless feedback loops, continuously improving the passageways of commerce. The smartness here is that of technical systems that render urbanites into subjects of cybernetic management, supposedly empowered by their involvement in perfectly organised urban environments, whether it be through models of efficiency or sustainability (see Gabrys, 2016: 185ff.). The intimate relationship between the smart city and logistics implies a certain foreclosure of the city's possibilities and virtual futures. Likewise, the cybernetic visions of computational control mask the limits of computation and the ways in which 'wicked problems' might require political rather than computational solutions (Goodspeed, 2015). Many accounts of smart cities that are dependent on extensive computational infrastructure including data centres, recognise the historical coincidence of cybernetic control and neoliberal capital. Even where it is machines which process the vast amounts of data produced by the city and the ruling and managerial classes disappear behind dashboards (Mattern, 2015), it is usually the logic of capital that steers the flows of data, people and things. Yet what other futures of the city may be possible within the smart city, what collective intelligence may it bring forth? Can one fathom the possible others of the logistical city in the visions of the cybernetic revolutionaries of Project Cybersyn (see Medina, 2011) or the cyberpunks of the 1980s? What other historical or contemporary examples of resistances to or alternative visions of ubiquitous computing the city could one draw on?

Clemens Apprich suggests that it might be worth revisiting some of the 'Babylonian dreams' of the informational cities of the 1990s. In his essay in this issue, Apprich recounts an historical moment where the phantasmagoria of virtual space met the crisis of the city: suddenly the city became a fruitful, usable metaphor for the emerging computational environment, whilst the computer and its network presented an opportunity to save the city by reconstructing it as a political and collective space (for an extended account see Apprich, 2015). Yet, the realisation of this dream in the shape of the network of networks – the Internet – was soon enrolled by neoliberal capital in the service of society and the *polis*, by imposing a market for what a bit later still would be known as 'Web 2.0' and today we refer to as platform capitalism. In this light, today's smart city behaves according to platform capitalism where individualised smart citizens happily demo for neoliberal life. Apprich urges us to return to the visions and challenges of the informational cities of the 1990s, since their dreams of horizontal networks, collective infrastructure ownership, and common public space, should still be ours today.

Dale Leorke recounts a parallel history in a discussion of Ben Russell's *headmap manifesto* (1999). The genre of the manifesto – its form, writing style, and affective message – certainly differs considerably from the white papers and marketing materials produced by the proponents of smart cities today. Leorke recounts the importance and influence of the manifesto for the development of locative media, and how in its wake a collective artistic movement of locative media came forth which produced some of the most exciting experiments with mobile and locative media to date. Yet the story also involves the moment where locative media were corrupted by commercial applications, and overtaken by Web 2.0 and platform capitalism. Leorke recounts that some, such as Andreas Broeckmann, saw this coming in their descriptions of locative media as the 'avant-garde' of societies of control; yet surely few would have been able to foresee the appropriation of locative media for both governance and commerce. Pokemon Go might stand in here as the epitaph to this development; even so, as we will see below, the politics of appropriation are at work in many places.

In focusing on the histories of how artistic and experimental developments in computational media have been appropriated for governance, and, by drawing a line from early urban development plans to today's digital infrastructures, it becomes evident that computing the city has to be understood as part of a transition of environments from habitats and spaces of dwelling to objects of planning, management and control. This also becomes apparent in the rise of urban informatics, explored here in the essay by Sarah Barns. The history of locative media as accounted for by Leorke serves as one precursor to the development of urban informatics (see Foth, 2009). Barns recounts how over the last ten years urban informatics has begun to consider the city as an urban laboratory for practical experimentation with forms of computation; recognising the pervasive nature of computing in the city and focusing both on infrastructure as well as softer, social aspects of computation. Where earlier phases of the field were concerned with a kind of 'app-tivism' and on crowdsourcing data and user participation as a method to reclaim the city, more recently the field has moved closer to enrolling computation for governance, for example in a preoccupation with simulation and predictive modelling of various aspects of the city, from traffic to policing. Barns, with Mattern (2016), questions the instrumentalism of urban informatics, and urges us to think beyond what she calls 'platform urbanism' towards a politics of data that is not as closely tied to governance.

Smart cities and urban informatics, then, are two approaches which seek to establish a perspective on what computing the city could be. The current talk of 'environmental media' and 'smart architecture' and the change from intelligently-built to intelligent houses or urban spaces resonates with imperatives of sustainability, the politics of control and the territorialisation of private and public space. Since the early electrification of domestic buildings, the presupposition was that spaces become places for the distribution of energy and information. New technical means now add to tendencies where smart homes in smart cities are transforming spaces of surveillance into environments of 'ubiquitous sensing' (Halpern et al., 2013: 291) by massive sensorial power, and urban citizens are being enrolled as 'citizen sensors' in environmental sensing (Gabrys, 2016: 187). Made up of plugs, switches and alarm bells, of sensors, chips and light barriers, these networks of small, distributed (and in the singular ineffective) agents collect data on movements and actions. In this sense, logistics defines not only the internal flows of the city but also what links these flows together.

Focusing on the sensorial, Jussi Parikka explores the elementary basis of distributed urban computing by showing how the two phenomena of smart dust and smog are related to infrastructural developments.

Sensing and the sensorial in the city, Parikka shows, cannot be separated when taking into account the ways in which the urban experience of air pollution is part of its production and presumably also of the collection of data. Smog thus appears as a way for making citizens sense. Capture, a mode of surveillance conceptualised by Philip Agre, is a way of collecting data hand-in-hand with the activity about which data is collected (Agre, 1994). Capture thus emerges as an integral part of smart cities and replaces or complements established modes of surveillance via monitoring. Parikka describes air, the most ubiquitous medium in all cities, as an aesthetic phenomenon that lends itself to various uses and abuses.

A focus on logistics highlights how the ubiquity of computing in the design of smart cities enables, optimises and speeds up the flows of commerce. While this starting point in a sense presupposes the dominance of neoliberal capital – both in its cognitive dimensions but also in all its material dimensions concerned with global trade – this of course hardly explains how logistics shapes the city. Therefore, it is necessary to explore how urban labour and life are modulated and managed by a politics of parameters – by key performance indicators, self-management and so on (see also Rossiter, 2016: 119ff.). In his essay, Soenke Zehle calls for a politics that questions and challenges the parameters imposed through algorithmic forms of governance in the smart city, and for a politics of ambient 'commoning' that seeks to rebuild and redesign the operational infrastructures of the city. As a mode of surrounding that does not determine the actions of what is surrounded, Zehle shows how the ambient emerges as a chance to explore the environmentality of smart cities.

The *polis*, in fact, is what is at stake here: the city not in the sense of a territory, but of the body of its members, ideally self-governed, autonomous and independent, though in historical reality only accessible for a certain class of humans. The ancient Greek *polis*, following Hannah Arendt, can be seen as the origin of western democracy and of western philosophy, and contains within it concepts that have developed into a common practice of the political that integrates public and private (Arendt, 1998). The central space of a *polis* is the *agora*, the market place, where also votes and festivities take place and where a collective identity is framed. The *agora* is the public space in which bodies assemble, which is a precondition of the political in antiquity. The other of the *polis* is, of course, the *oikos*, the house with its domestic economy and ecology, the private space of the family. How is this relation between *polis* and *oikos* transformed, when ubiquitous computing in the city means that power becomes environmental, and urban citizens themselves become sensors that take part in urban governance (Gabrys, 2016)? As citizenship here is remodelled, does it allow for us 'not to be governed quite so much', as Gabrys explores (2016: 190); or does 'self-droning', the transformation of humans into 'networked, sensing devices' (Andrejevic , 2015), result in economic logics usurping any site for politics in the city?

What we witness today with the rise of smart cities is a new relation of public and private spaces, in which public spaces become privatised and private spaces are spied out by public institutions and potentially citizens themselves. When we talk about the computerised city, it is still fruitful to return to the idealised Greek concepts of *polis*, of *oikos* and of *agora* – perhaps not only in the sense in which William J. Mitchell spoke of an electronic, disembodied agora in the 1990s, but also through the actions of the Occupy movement and Anonymous. The Occupy movement and Anonymous negotiate the relation of private and public: in 2011, activists all around the world occupied public spaces with their own bodies, which were threatened to become privatised, in order to protest against speculative practices of capitalism and the privatisation of common goods. With their own bodies, and with the help of the technical infrastructures – such as tents – that make up the 'other media' of Occupy (Feigenbaum, 2014), the occupants reclaimed a

public that has been lost. Anonymous, on the other hand, stays private in becoming public. By masking themselves, Anonymous create a collective identity that rises as an imaginary body hiding the private by presenting the public.

With regard to these examples, computing the city suggest we explore how digital technologies constitute *polis* and *oikos* in new ways, how they perhaps destroy the traditional assemblage of the city and replace it with a new one, how they bury public and private spaces and open new spaces which we still have to describe. In this vein, Paula Bialski shows how public and private spaces of action overlap when they are performed by improvised co-ordinations between human and non-human actors. Drawing on an ethnography of train ticket sharing, Bialski argues that those 'parasitic infrastructures' that live in and off commercial registers are the result of coordinated attempts to undermine hegemonic uses of infrastructure. Bialski's examples refrain from showing another mode of user participation in which immaterial labour is exploited. Instead, they explore the exploitation of infrastructures by users who employ technological devices in non-hegemonic ways on a daily and non- or semi-professional basis. The 'smartness' of the city is thus counteracted by a more unstable smartness that redevelops its own paths of distribution and attaches to both human and non-human actors. A strategy of action in smart cities could consequently consist in remodelling user smartness and the technologies that enable new forms of collectivity.

Bialski shows that the capture of movement can be used for different purposes. With technologies of tracing and tracking we witness a transition from modes of addressing to modes of positioning, in which addressed distribution is replaced by information about the position of the addressees and the imperatives of their movement (Thrift, 2004). The paradigmatic technologies of RFID and GPS not only serve the determination of positions, but control positioning at specific places, because they not only register movements, but start to determine movements. In the last decade this process has revolutionised logistics and the daily use of mobile media, and this has opened a multidimensional politics of environments, which questions our understanding of space and home by deferring the distinction of inside and outside, of private and public. This has led to the necessity of new architectonic concepts and urban plans, followed by a re-purposing of architectural spaces as positioning spaces, in which objects are constantly identified, addressed and related to the position of other objects. All of them act as actors of distribution in encompassing technical environments (Rosol, 2010).

In this context, urban studies has become a prevalent field of research for which questions of media, especially the media of representation such as television or graffiti, have become central. Recently, perhaps most prominently in Stephen Graham and Simon Marvin's book *Splintering Urbanism* (2001), questions of digitisation have been foregrounded. These debates reach back to the early and euphoric discourses on the Internet, the communication super highway, and on new forms of connectivity, as they were presented in William J. Mitchell's seminal book *City of Bits* or in Manuel Castells' work. They also react to transformations of computing hardly visible at that time: technologies of tracing and tracking, technologies transforming urban spaces into environments, and technologies of new forms of traffic and mobility. Their infrastructures consist of cables, plugs and switches, of pipes, outlets and windows, of routers, sensors and waves, of media underlying media as infrastructural backgrounds. When architecture becomes environmental – as architectural critic Reyner Banham already intuited in the 1960s – this fundamental change can only be understood by taking into account technological infrastructures: 'When your house contains such a complex of piping, flues, ducts, wires, lights, inlets, outlets, ovens, sinks, refuse disposers,

hi-fi re-verberators, antennae, conduits, freezers, heaters – when it contains so many services that the hardware could stand up by itself without any assistance from the house, why have a house to hold it up?' (1965: 109).

To put it another way: to understand the computerised city, we have to neglect the computer and find a conceptual language that emerges together with the organisational principles both of computing and architecture of the second half of the 20th century. The threat of fetishising technology can be prevented by conceiving of technology as no longer separate from sociality. The computerised city is a prime example of this tendency: if this urban infrastructure is modified or even if its traditional functionality is called into question, then ineluctable repercussions for the constitution of the social arise. Consequently, social inequalities, differences and struggles are necessarily part of the collected investigations in computing the city. In this sense, the essays in this issue focus on the infrastructures of distribution rather than on what is distributed. Circulation in the city is thereby understood as a process of interconnected movements of objects, people and data. This process, without doubt, is very relevant to definitions and experiences of meaning and identity (see Boutros and Straw, 2010), but is also part of a remodelling of infrastructural spaces. Distribution on a spatial scale and circulation on a temporal scale both establish different patterns and rhythms that become subject to processes of digitisation.

An exploration of the current regime of computing cannot be restricted to the urban or the domestic scale. Both dimensions can only be understood in their relation, as the oppositions of private and public, as inside and outside are constantly negotiated alongside the emergence of new technologies. Following these topics and opening up new perspectives on the interrelation of distribution, digitisation and logistics, the essays in this issue of *The Fibreculture Journal* share a common denominator: the assumption that the smart city is not a phenomenon that will go away but that it is our task to define what smartness in a city means. Calculation and computation, distribution and circulation are shown to be matters of imagination.

Biographical Notes

Armin Beverungen is currently Junior Director at the Digital Cultures Research Lab at Leuphana University Lüneburg. He studied organisation studies and sociology in Lancaster and Cambridge, before completing his PhD on the reception of Marxism in the business school at the University of Leicester in 2010. He has published on the university, financialisation, business ethics, open access publishing, value struggles in the city and digital labour. Armin is involved in a long-term project to engage media and organisation theory, currently focusing on the phenomenon of algorithmic management. He has for many years been involved in open access publishing (with *ephemera: theory & politics in organization*) and is currently a member of the editorial collectives of the open access journal *spheres: Journal for Digital Cultures* and the book series *Digital Cultures* (Meson Press, Lüneburg).

Florian Sprenger is Junior Professor for Media and Cultural Studies at Goethe University Frankfurt. He studied media studies and philosophy at Bochum, Weimar and Vienna. His PhD on *Media of Immediacy – Electricity, Telegraphy, McLuhan* was published in 2012. Before becoming a part of the Digital Cultures Research Lab at Leuphana University Lüneburg he was Visiting Scholar at Stanford University. His research covers topics such as the history of artificial environments, media of immediacy, and the internet of things. He is part of the research project *Data Centres and the Governance of Labour and Territory* at Western Sydney University. He recently published the monograph *Politics of Microdecisions – Edward Snowden, Net Neutrality*

and the Architectures of the Internet (Lüneburg: Meson Press, 2015).

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Notes

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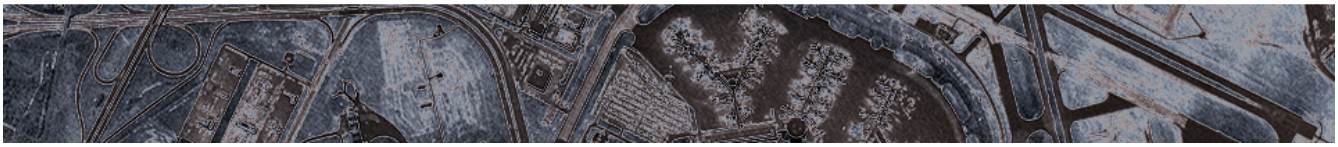

FCJ-213 Babylonian Dreams: From Info-Cities to Smart Cities to Experimental Collectivism

Clemens Apprich, Leuphana University, Lüneburg.

Abstract: In the 1990s the controversy about the dangers but also possibilities of data networks was influenced by a concern about the spatial transformation they cause. As a consequence, the alleged decline of cities began to overlap with the emerging discourse about network technologies. The following paper examines this debate using the example of Info-Cities as a spatial metaphor to describe data space. Retracing this technotopia back to the early stage of network building should help us to better understand current discussions on ubiquitous computing in urban environments, and, finally, allow us to re-imagine digital networks as complex, heterogeneous and transversal structures.

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> Welcome to post-liberal Los Angeles, where the defense of luxury lifestyles is translated into proliferation of new repressions in space and movement, undergirded by the ubiquitous "armed response". This obsession with physical security systems, and, collaterally, with the architectural policing of social boundaries, has become a zeitgeist of urban restructuring, a master narrative in the emerging built environment of the 1990s. [...] Images of carceral inner cities (*Escape from New York, Running Man*), high-tech police death squads (*Blade Runner*), sentient buildings (*Die Hard*), urban bantustans (*They live!*), Vietnam-like street wars (*Colors*), and so on, only extrapolate from actually existing trends. (Davis, 1990: 223)

In his bestselling book *City of Quartz*, Mike Davis, urban sociologist and rigorous chronicler of his Southern California home, described the imminent end of the 'California Dream' in the early 1990s (cf. Davis, 1990). By 'excavating the future in Los Angeles' (the subtitle of his book), he portrays the decay of California's largest city and thereby scratches the glittering surface of 'Tinseltown'. According to Davis, the commercial, business and cultural center of the US-American West runs the risk of becoming the victim of its own million-fold reproduced image. Hollywood's dream factory is not only creating the image of the ideal suburban life, but also evokes the deadly perils of inner cities. Consequently, the fictional scenarios, fostering a culture of fear, are deeply penetrating into the built architecture of the city itself, as can be seen

with the example of the Bunker Hill Redevelopment Project. Since the 1960s, when social unrest erupted in downtown L.A., public funding has been used to demolish old apartment buildings, and to replace them with a hermetically sealed-off financial district. At the same time, laws have been tightened and security forces expanded, culminating in the militarisation and rigorous zonation of city life during the Reagan era. And since the Rodney King Riots of 1992, the Los Angeles Police Department (LAPD) has become one of the most influential voices in urban development issues, without whose consent no major project can be carried out today. In a follow up to his book, Davis referred to the 1982 film *Blade Runner* as 'L.A.'s own dystopic alter ego' (Davis, 1992: 1). The future of L.A. is reflected in the dark rendition of Ridley Scott, a virtual shadow that is overlaying the *City of Angels*.

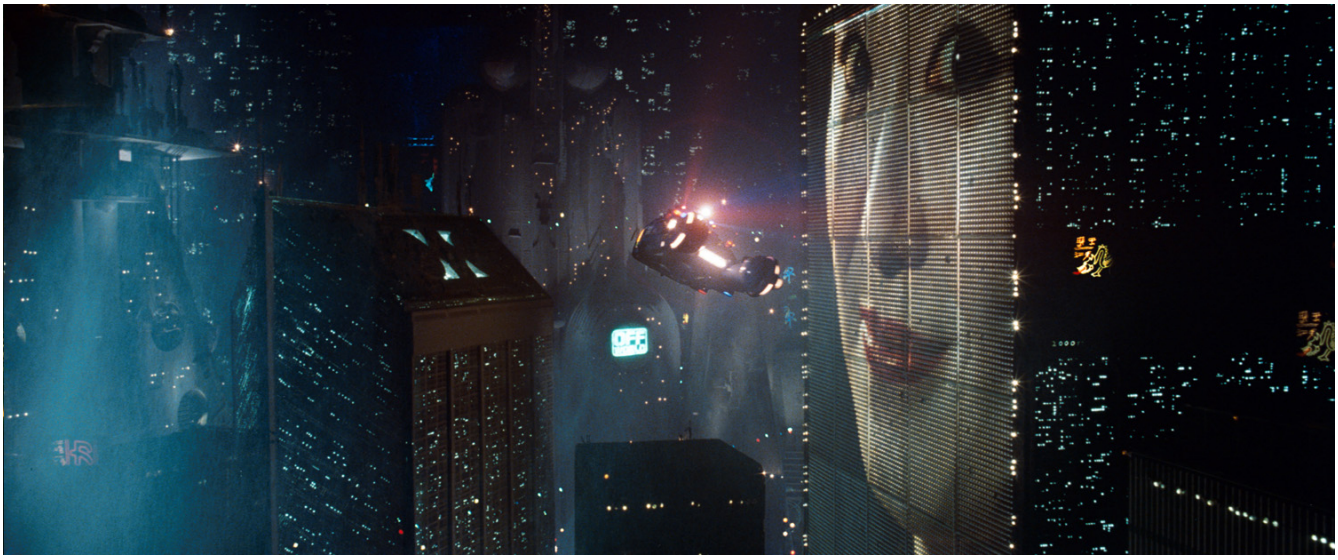

Figure 1. Ridley Scott, Blade Runner (1982).

Despite this powerful and unique image, *Blade Runner* remains yet another figure of modernist thought in which the possible future city can only be envisioned as a grotesque distortion of the present. This line of thought ranges from H.G. Wells' *The Future of America* (1906) to Fritz Lang's *Metropolis* (1931) to Christopher Nolen's *The Dark Knight* (2008), and follows the teleological idea of an idealised – alternately utopian or dystopian – future. But 'instead of seeing the future merely as a grotesque, Wellsian magnification of technology and architecture', Davis wants to 'carefully extrapolate existing spatial tendencies in order to glimpse their emergent pattern' (Davis, 1992: 2). And for him such a pattern shows up in the 'prefigurative social theory' of William Gibson, who was the first to describe the political, social, as well as cognitive function of a new computer-generated space in his novel *Neuromancer* (1984). This space is called 'cyberspace' and Gibson compares it to the receding lights of a city, a 'consensual hallucination' (Gibson, 51) which is experienced by billions of users on a day-to-day basis. Mainly because of this plain and simple description, the term turned out to be extremely popular, used by different sides to describe the emerging reality of digital technologies:

> From the moment William Gibson announced in his dystopian science-fiction account *Neuromancer* (1984) that the new informational network or computer matrix called cyberspace looks like Los Angeles seen from five thousand feet up in the air, there has been a predilection for drawing a parallel between the virtual space of computer networks and post-urban places of disorder and decay. (Boyer, 1996: 13)

Particularly in the 1990s, cyberspace was used as a synonym for virtual reality, which, paradoxically, turned

out to look like the crisis-ridden city.

The Crisis of the City

The image of Los Angeles as a city of decay did not simply refer to the dystopian vision of some disenchanted cyberpunks. Rather, the envisioned crisis of the city marked a general crisis of governance at the end of the 20th century: the modern city, which was characterised by its centrality, was replaced by the postmodern city, whose built architecture got more and more overlaid by global data flows, thereby fragmenting the traditional structure of the city and reassembling it according to the needs of multinational capitalism (cf. Castells, 1991; Sassen, 1991). For cultural theorist Fredric Jameson this marks the

> moment of the multinational network [...] in which not merely the older city but even the nation-state itself has ceased to play a central functional and formal role in a process that has in a new quantum leap of capital prodigiously expanded beyond them, leaving them behind as ruined and archaic remains of earlier stages in the development of this mode of production. (Jameson, 1991: 412)

Late capitalism, therefore, has to be analysed by its cultural logic, which finds its expression in a new space of computer networks and implies a dramatic change in our cognitive capacities to grasp this space: 'We are submerged in its henceforth filled and suffused volumes to the point where our now postmodern bodies are bereft of spatial coordinates and practically (let alone theoretically) incapable of distantiation' (Jameson, 1991: 48f.). In the 1990s the sprawl became the symbol of an urban space that was not defined any more by clear-cut boundaries, but resembled the spatially distributed structure of new information and communication networks. Hence, the discourse about the dangers, but also possibilities of data networks, was influenced by a concern about the spatial transformation they cause: 'The dramatic changes in information technology deeply affect the core of our system, and in so doing lie at the very roots of its spatial pattern of change' (Castells, 1991: 126). And, as Manuel Castells describes in his three-volume work on the information age, this process is driven by the increasing dominance of the 'space of flows' over the 'space of places' (cf. Castells, 1996).

The discussion about a crisis of the city is probably as old as the city itself. However, what is striking about the early 1990s is that the debate about the alleged decline of cities began to overlap with the emerging discourse about digital technologies (cf. Fuchs and Moltmann, 1995; Mitchell, 1996; Iglhaut, Medosch and Rötzer, 1996; Maar and Rötzer, 1997; Rötzer, 1997; Lévy, 1997). The discussion took place mainly between two camps: on the one side, Internet enthusiasts promoted the conquest of the new territory in the hope of leaving the old world with its galling problems behind; on the other side, techno-sceptics cherished the same old world for its clarity and comprehensibility. For the latter, the urban space had been infiltrated by digital technologies, and, in this process of virtualisation, traditional functions of the city, such as providing meeting points for its inhabitants, were considered to migrate into cyberspace. In this view, a computer-generated dis-urbanisation was taking place, creating a post-architectural city where 'physical architecture and urbanism as a derivative of the ancient cities of the past will be something to be avoided. Something to be associated with danger, penalties, congestion and delay. Something best forgotten' (Pawley, 1997: 548).

Figure 2. Knowbotic Research, IO_dencies Tokyo (1997)

The 'death of architecture' (Manovich, 1996: 39) ultimately implied the downfall of the city as the former centre of cultural and economic development. Beyond a centralised space, new media apologists began to dream of a tele-existence, which was no longer dependent on spatial proximity. In fact, a new 'virtual class' (Kroker and Weinstein, 1994) was supposed to leave the narrow space of the city, in order to settle in rural, yet well-connected areas. Linked to this vision was a – mainly white male – idea of individual freedom and unrestricted mobility, encapsulated by the image of an 'information superhighway' and propagated by the so called *Californian Ideology* (Barbrook and Cameron, 1996). The notion of an electronic frontier, beyond which a new and promising land was imagined, played a crucial role in the popularisation of cyberspace. In accordance with the old myth of the Wild Wild West, the actual WWW provided the tool to discover and colonise the electronically produced space. [1] Hence, with the Internet the computer was not simply seen as a numerical calculating machine anymore – the mechanical calculator had been around since the 17th century – but rather as new symbolic system:

> The crucial technological breakthrough lies with this idea of the computer as a symbolic system [...]. Those pulses of electricity are symbols that stand in for zeros and ones, which in turn represent simple mathematical instruction sets, which in turn represent words or images, spreadsheets or e-mail messages. (Johnson, 1997: 14)

While machines were understood as a prosthetic supplement to the human body during the 19th and well

into the 20th century, the power of the digital computer arose from its capacity for self-representation: 'For the first time, a machine was imagined not as an attachment to our bodies, but as an environment, a space to be explored' (Johnson, 1997: 24). And, given the fact that the digital space is simply a sequence of zeros and ones, there were numerous ways in which it could be made visible; thereby leading to the question of why the city became such a prominent metaphor to describe data space in the 1990s.

As Walter Benjamin already noted in the 1930s, new technological developments stir our cultural imagination. However, the unconscious production of these images is not detached from our past: we collectively dream of a future, where the old is suspended in the new (Benjamin, 1983: 46f.). In this sense, the new virtual space of the 1990s appeared as a phantasmagoria, a collective belief that 'being released from reality and all of its messy and uncontrollable chaos enables the virtual to recover reality, even while, paradoxically, it implicates a withdrawal from it' (Boyer, 1996: 6). So all hopes to overcome the crisis of the city were pinned to those technologies that were held accountable for the emergence of this crisis. While initially the discussion had revolved around the question of a dissolving urban space, allegedly caused by the mass distribution of network technologies, cyberspace henceforth hold the promise of an ideal space that could revitalise the main functions of the city and foster new forms of community building (Rheingold, 1994). As a consequence, virtual space, which 'called for a series of new metaphors, new rules and patterns of behaviour' (Bollmann, 1995: 164; my own translation), was represented as urban space. While engaging with the digital sphere, the image of the city with its organising principles proved to be tremendously useful to grasp the unintelligible environment of computer-generated space and, therefore, to cope with the postmodern 'loss of orientation' (Virilio, 2001). [2]

This seems to be reasonable, given the fact that the city metaphor has a long history in describing technological media (Kittler, 1995). By the same token, one may argue that the city itself has always been characterised by information, communication and transport technologies (Böhme, 2004). As German cultural scientist Hartmut Böhme points out, the systematic networking of urban space began as early as the industrial revolution; however, with the mass distribution of computer-based networks since the 1990s, the 'city as network' has undergone an unprecedented intensification, implicating a qualitative change. Hence, the material architecture of the city has been permeated by local, national and global networks, to the effect that the management of urban infrastructure – from transport to communication to energy supply – is no longer imaginable without the presence of digital information networks. Since the 1990s the city has been overcoded by software-ensembles, which are necessary to control the new flood of information. In this sense, the physically built environment of the city does not simply disappear, but its readability and controllability are more and more dependent on computer networks – in particular the Internet. Whether electronic timetables, GPS-based maps or online-systems in municipal administration, the digital representation of urban processes has become – at least in this perspective – a second reality, yielding a new landscape built out of data (Gelernter, 1992). [3]

Info-Cities, or: How Did the City Come into the Net?

In the 1990s the new data space was waiting to be filled with meaning. A whole new academic genre emerged, situated between architecture, communication and urbanism. One of the best known proponents of this genre was William Mitchell, whose *City of Bits* (1996) became one of the main sources for the conception and the understanding of virtual spaces. In contrast to the popular image of the 'global village' (McLuhan, 1964), which still represented a rather definite and easily comprehensible entity,

Mitchell's soft cities had already lost their structuring differentiation vis-à-vis the surrounding data sphere. With the massive proliferation of personal computers and their increasing interconnection, the information landscape had changed: 'Early computers had been like isolated mountain valleys ruled by programmer-kings [...]. But networking fundamentally changed things [...] by linking the increasingly numerous individual fragments of cyberturf into one huge, expanding system' (Mitchell, 1996: 109f.). In order to keep track of this rapidly expanding computer network, interfaces had to be developed which made the navigation through cyberspace feasible. So-called 'mirror worlds' were supposed to enable a new kind of 'whole-sightedness' (Gelernter, 1992: 31), as computer scientist David Gelernter put it. For him, a mirror world 'is some huge institution's moving, true-to-life mirror image trapped inside a computer – where you can see and grasp it whole' (Gelernter, 1992: 3). Like a microscope, or more precisely, a telescope, these software-ensembles are tasked to render data space into something observable and therefore comprehensible. Given the importance of metaphorical language to depict the binary coding system, a critical analysis of the metaphors in use is as relevant as the understanding of computer code itself.

Since human-computer interfaces do not originate in a neutral space, the question remains: why did the city become such a popular trope and organising principle in the visual world of cyberspace? This may primarily be related to the fact that metaphors are often used to conceal, or at least obscure cultural transformations. In this sense, emerging technologies are often understood in terms of earlier innovations, as Mitchell explains in an interview:

> the automobile was first called the "horseless carriage", so it is like a carriage without a horse, and the radio was first called the "wireless telegraph", it is like a telegraph without wires. [...] I think the same thing has been happening with the internet – we began to understand it in terms of these metaphors from architecture. (Mitchell, 2005: 2) [4]

At the turn of the millennium, the city metaphor established a new symbolic order and constituted – at least for a short period – the core idiom of cyberspace. Hence, not only had the city become a data space with the mass distribution of network technologies, but the data space, generated by these technologies, was represented as a city.

In the early 1990s a postgraduate student at Vienna University of Technology (TU Vienna), Andreas Dieberger, coined the term *Information City* (1994) to describe a spatial user interface. In order to resolve the problem of 'getting lost in hyperspace' (Dieberger, 1993), Dieberger's city metaphor attempted to make the structure of information systems easier to understand by drawing a cognitive map of the information space. He proposed to use architectural knowledge from city planning in order to build an information environment that would help users to navigate hypertext. His information city defined an 'ontology of spaces and connections that is useful [...] to create structure in an unstructured information domain' (Dieberger, 1998). By implementing the hierarchical concept of the city, Dieberger was able to develop a rich set of navigational tools. For him cyberspace, like the city, was constructable and therefore controllable: 'An important advantage of ... city metaphors is that they define several levels of enclosed spaces' (Dieberger, 1998). The elements of a city (i.e. the district, the neighbourhood, the block, the building, etc.) were seen as 'ideal sources for metaphors that describe strong encapsulation and access control' (Dieberger, 1998). Using the existing knowledge about its structured environment, the city provides an organisational regime. [5]

Figure 3. MIT Media Lab, City of News (1996)

Although Dieberger's *Information City* was never realised, there were a whole series of projects in the 1990s that came close to his idea of a structured information space, in particular MIT's *City of News* (first completed in 1996). Quite similar to Dieberger's concept, an information environment was built, within which the user could draw on his or her experiences in actual cities: websites were visualised as buildings which themselves were organised in urban districts according to their specific content: the finance district, the shopping district, the district of science. In order to retrieve the content, a browser was designed 'that organizes information as it fetches it, in real-time, in a virtual three-dimensional space which anchors our perceptual flow of data to a cognitive map of a (virtual) place' (Sparacino et al., 1997). In this sense, the *City of News* can be understood as a precursor of today's data management systems, which require an exact search term and an understanding of the basic structure of the database. Not only was the city a dynamic space, where every new website was represented by a new building, which, in turn, grew with every click, but because of its immersive logic, the cognitive map literally invited its users to search by strolling. Herein lies the promise of an ideally structured knowledge space: 'City of News certainly participates in the utopian dimension of this historical line of thought as it carries within itself a hope for an ideal space of information sharing and consumption' (Sparacino et al., 1997). This utopia involved the notion of a functionally zoned city, and drew on a variety of concepts in modernist architecture and town planning (for example Le Corbusier, Ebenezer Howard, Archigram, EPCOT), where the city is characterised by an organisational regime of inclusion and exclusion. Hence, the concept of the city was applied to cyberspace in the 1990s in order to draw a line between the visible and the invisible, the expressible and inexpressible, order and chaos – a virtual Jerusalem set against the Babylonian confusion of data streams.

This model of the ordered city implies a significant foreclosure of the possibilities of cyberspace as a potentially open and non-hierarchical space: Info-Cities correspond to a parallel space, a virtual reality

constituted by its boundaries. In this sense, Dieberger's *Information City* as well as MIT's *City of News* were still in line with the notion of the information superhighway, which 'privileges the individual user exploring a relatively homogeneous information space' (Bolter, 1996). In this vision, the user ranges all-alone through the virtual streets of the Info-City in search for human traces, which he or she only catches sight of in the form of abstract data sets. In contrast to this solipsistic concept of virtual space, at the same time the city metaphor evoked an image that was collective, heterogeneous and social, as can be seen by the example of so-called digital cities (for example, in Europe, Amsterdam, Berlin or Vienna). [6] Instead of merely applying the hierarchical structure of the city in a digital environment, in order to define an enclosed and idealised space of knowledge, the Internet had also been considered to be an open environment, a city as such, with all its functions, potentialities and shortcomings. Digital technologies, in this perspective, were not only seen as technical media, but also as social environments, yielding new forms of cultural production and interaction. It was this tension between an individualistic and a collectivistic understanding of media spaces that shaped the debate about digital networks during the 1990s (see also Apprich, 2015). [7]

Imagining Networks

The historical example of Info-Cities illustrates that urban computing is not only about the physical application of computer technologies in domestic and urban spaces, but also about the cultural imagination triggered by this implementation. By making use of the city as organisational regime, the attempt was made to manage the supposed chaos in digital space. In this sense, the idea of gathering and structuring knowledge within the city referred to the old wish of informational control. However, this idea of an ideal knowledge space was never really disconnected from the real world. Cyberspace in the 1990s did not merely represent a 'new pure continent' (see also Barbrook and Cameron's Californian Ideology), but was rather the subject of a constant struggle over the establishment of a new symbolic order, as can be seen from the competing imaginings of what this space should look like. In this sense, every human computer interface contains some sort of metaphor (for example laptop, desktop, folders, trash can, windows, etc.). The interface determines how the user conceives the computer itself and the world accessed via this computer. As media theorist Lev Manovich observes, this means that 'Far from being a transparent window into the data inside a computer, the interface brings with it strong messages of its own' (2001: 65). By organising the digital space in specific ways, the interface provides distinct models of the world. Every time we use the Internet, everything we access (such as texts, images, photographs, videos, music or whole virtual environments) has already been filtered by these cultural interfaces. As a consequence, symbolic representation has played a crucial role in the formation of digital media cultures.

This sort of media-becoming, described by Alexander Galloway in his book *The Interface Effect* refers to a process, rather than a thing: 'the computer is not an object, or a creator of objects, it is a process or active threshold mediating between two states' (2012: 23). [8] Instead of simply providing a gate to an enclosed space, as was the case with Dieberger's *Information City* or MIT's *City of News*, the digital interface understood as a threshold represents practices of mediation between the inside and the outside, between the data space and the social space. While text-based terminals – for a long time the only possible form of human-computer interaction – require a technical understanding of the underlying structure, graphical user interfaces facilitate the interaction with computers by employing our everyday knowledge. In this process, the interface becomes virtually invisible:

> Windows, doors, airport gates, and other thresholds are those transparent devices that achieve more the less they do: for every moment of virtuosic immersion and connectivity, for every moment of volumetric delivery, of inopacity, the threshold becomes one notch more invisible, one notch more inoperable. (Galloway, 2008: 931)

The more effective, that is, the more intuitive the interface is, the more it seems to disappear from the actual screen in front of the user. Hence, it was not by accident that the city was one of the most meaningful metaphors in the early days of the Internet. The city with its long history of urban morphology provided a familiar image for its users, while at the same time being defined by its built environment, which allows it to conceal the underlying networks.

Figure 4. Jean-François Lyotard, Les Immatériaux (1985)

It becomes clear that the metaphor of the city was employed in the 1990s to tackle what Fredric Jameson identified as postmodern confusion. This confusion, as was mentioned before, was caused by 'the incapacity of our minds, at least at present, to map the great global multinational and decentred communicational network in which we find ourselves caught as individual subjects' (Jameson, 1991: 44). Because of the overlap of a local physical and a global data space a new complexity emerged, which can be read as the most recent push for modernisation. In this postmodern situation, defined by a process of digitisation and, consequently, new assemblages of people and technologies, the network became the determining morphology of society. But instead of rooting this transformation in technological development itself, Jameson stated that 'our faulty representations of some immense communicational and computer network are themselves but a distorted figuration of something even deeper, namely, the whole world system of a present-day multinational capitalism' (1991: 37f.). The challenge to grasp,

understand and criticise this decentralised global network of power and control led to the idea of cognitive mapping, in order to tackle the problem of representation and representability.

In this sense, the network can be understood as a 'control allegory' (Galloway, 2008: 99), an allegorical device that helps us to grasp the cultural transformation in the age of late capitalism. However, in the transition from one cultural form of organisation to another, metaphors – as described above – do not only serve the better understanding of this transformation but also its obfuscation. Hence, the network itself has to be analysed as an expression of the current socio-economic situation. As digital networks became more and more interconnected with physical space, the idea of a homogeneous information space was no longer sufficient to describe the increasingly complex network sphere:

> As our machines are increasingly jacked into global networks of information, it becomes more and more difficult to "imagine" the dataspace at our fingertips, to picture all that complexity in our mind's eye. (Johnson, 1997: 18)

As a consequence, the city metaphor, defined by its hierarchically structured ontology, lost its attraction to describe data space; it made way for the rather abstract image of the "network". Not only, as Wendy Chun recently suggested, was the idea of the network considered to bring some clarity into the postmodern world, but it also resonated with the socio-economic shift of that time: 'networks have been central to the emergence, management and imaginary of neoliberalism, in particular to its narrative of individuals collectively dissolving society'. (Chun, 2015: 289) In this sense, the proclaimed crisis of the city in the 1990s is closely linked to neoliberal attempts to deterritorialise urban and social structures, in order to adapt them to the new conditions of global capital. The dissolution of the social involves the imagination of neoliberal networks, which, from now on, are supposed to connect human and non-human individuals.

Platform-Capitalism

New information and communication technologies have for a long time nurtured the hope of a "Third Wave" (see especially Toffler, 1984). According to this framework, a third socio-economic revolution is taking place: after the agricultural and the industrial era, in the aftermath of the Second World War most countries – at least in the West – have been transformed into post-industrial, knowledge-based societies. With the collapse of the Soviet Union and the end of the rivalry between the competing East and West systems, the idea of a third wave got picked up by neoliberal opinion leaders like Alvin Toffler, for whom the information age enables the replacement of industrial-style, centralized, top-down bureaucratic planning by 'a more open, democratic, decentralized style' (Toffler, 1987: 50). For the virtual class the technological discourse was vital, because it represented a new techno-religion that promised nothing short of the emergence of a whole new civilization, built on the free enterprise spirit of Silicon Valley. But despite the anti-state rhetoric of techno-libertarians, the transformation was not left to the market alone; rather, it was driven by large-scale public investment programs, as can be seen from Bill Clinton's *National Information Infrastructure* (NII) initiative of 1993. After the Berlin Wall came down the idea of a market-driven revolution, supported by state subsidies, was in full swing in the US and Europe. In 1994 European Commissioner Martin Bangemann presented his report *Europe and the Global Information Society* (1994), which was an attempt to keep pace with the NII-initiative. The claim was made to free the entrepreneurial spirit from the constraints of state monopolies and, therefore, to unleash a new information economy, which 'should be entrusted to the private sector and to market forces' (Bangemann, 1994: 34). [9]

Figure 5. Nam June Paik's Electronic Superhighway (1995)

In order to bring about a market-led change, the US and Europe were supposed to accelerate the liberalisation of the telecom sector, to foster competition within this market, to ensure legal protection of intellectual property rights and to concentrate public investments on the development of information technologies. This neoliberal approach reflected the technicist default setting of the 1990s, according to which the information society was a necessary imperative to lead the old industrial states to a brighter future. However, the desired leap ahead, both in terms of technical invention, and in terms of social innovation, simply repeated the liberal idea that capitalist market economy is the only guarantor for a democratic society – except that this time the liberalisation would not simply reform but dissolve society. In other words, individuals would no longer be governed by means of social institutions such as parties, unions or state organisations, but rather through self-managed communities (Rose, 1996: 332f.). Hence, in the wake of the so called 'digital revolution' the hitherto last push of neoliberal transformation had taken place, during which the market became the only structuring principle in Western societies (Mirowski, 2009).

After the burst of the dot-com bubble, the commercialisation of the Internet slowed down. But soon the catch phrases of participation, democratisation and decentralisation began to generate a new business field: 'Web 2.0 is the business revolution in the computer industry caused by the move to the Internet as a platform, and an attempt to understand the rules for success on that new platform' (O'Reilly, 2005). With 'Web 2.0' a label was found with which to proceed with the capitalisation of network technologies. By commodifying user-generated content, new online-platforms turned the idea of user participation into a profitable business model, thereby giving capitalism an answer to the challenges of the evolving digital environment, and in particular non-commercial sharing cultures. The relational character of social media allowed for a new culture of connectivity in the form of an 'advanced strategy of algorithmically connecting users to content, users to users, platforms to users, users to advertisers, and platforms to platforms' (van Dijck and Poell, 2013: 9). In this sense, the initial dream of egalitarian communication systems was incorporated by a new platform-capitalism, to the effect that users became the source of permanent data production, while at the same time being targeted by ubiquitous advertising.

Similar to electronic mass media (for example radio and TV), the power of social media lies in a capacity to impose their logic on other areas of society: 'Far from being neutral platforms for everyone, social media have changed the conditions and rules of social interaction' (van Dijck and Poell, 2013: 2). In this sense, networking sites favour the atomisation of users, because only isolated users can be (re-)connected according to pre-programmed patterns of interaction (as friends, followers, members etc.). The user, in this model, is an already fixed point, an identifiable, thus exploitable node within the network. As was the case with the virtual space of Info-Cities, commercial online-platforms impede any form of real sociability, understood as a free and spontaneous association of individuals. They are the direct expression of neoliberal governmentality (see Foucault, 2009). Thus, the ontology of today's predominant network model, in particular its socio-metrical portrayal of social networks as nodes and links, reinforces the political thinking that society is simply a conjunction of individuals seen as social atoms (Hui and Halpin, 2013: 106).

Smart Cities, or: How Does the Net Come into the City?

Since the 1990s, the neoliberal discourse has transformed the existing solidarity principle into a connectivity paradigm, leaving a disparate field of communities run on networks. As a result, technological change interlinks with a social transition by dissolving the previous structure of society and therefore stretching digital networks over the yawning gap. In this situation, the networked platform becomes a new model of algorithmic governance, as can be seen from current projects in urban development. In this context the 'phrase *smart city* can feasibly be applied to a large number of diverse international projects that range from the updating of telecommunication infrastructures to the construction of entirely new, planned cities' (Halpern et al., 2013: 276). As such, these digitally enhanced urban environments correspond with commercial online-platforms; like Facebook and Google, smart cities represent enclosed spaces, whose purpose it is to collect as much data as possible from different sources, such as humans, vehicles and buildings. Examples like the 'New Songdo City' in South Korea, 'Masdar City' in Abu Dhabi and 'PlanIT Valley' in Portugal, show how the envisioned city is built upon a physical computing infrastructure, composed of ubiquitous sensing technologies, advanced data management and novel visualisation methods.

Figure 6. HOK, New Songdo City (2010)

In particular 'New Songdo City' is an example of what Adam Greenfield calls 'canonical smart cities' (Greenfield, 2013: 11), that is cities built in generic space. 'New Songdo City' has been built from scratch on 1500 acres of reclaimed land in the Yellow Sea, 40 miles South of Seoul. With an estimated investment volume of $40 billion it is the hitherto largest private real estate development in history and truly a city of superlatives: besides being home to South Korea's highest building, it is built around a central park that holds 10% of the total area, surrounded by 20 miles of bicycle lanes and three international campuses, hosting the University of Utah, George Mason University, and the State University of New York at Stony Brook. The city's fate is deeply aligned to US-American investors. Since the South Korean government approached the New York-based real estate company Gale International about developing a city in close vicinity to Incheon International Airport in 2001, Songdo has been set up as a gigantic for-profit project, in order to attract multinational corporations and turn the region into the world's gateway for north-east Asia. [10] In cooperation with South Korea's steel-making giant POSCO and Western tech-companies like Cisco the smart city was built as an integrated high-tech environment (see Clarke, 2013: 14f.). An intelligent urban infrastructure has been designed from the ground up to monitor and regulate almost every inch of urban life – from energy consumption to traffic to home entertainment. Smart cities, in this sense, are supposed to improve resource efficiency, distribution of services, and, urban participation: 'Although cities infused by digital technologies and imaginaries are not a new development, their implementation to achieve

sustainability directives under the guise of smart cities is a more recent tactic for promoting digital technologies' (Gabrys, 2014: 31f.). According to urban sociologist Jennifer Gabrys the old promise of sustainable urbanisation is now being associated with 'sensor-based ubiquitous computing across urban infrastructure' (2014: 30), leading to a new regime of environmental governance (see Foucault 2008: 260ff.).

Songdo is supposed to provide templates for technological efficiency and urban sustainability, thereby creating an experimental field for new investment opportunities that have yet to prove themselves in conventional cities. The idea of a low carbon city reflects South Korea's aim to build a green infrastructure: In 2010 former president Lee Myung-bak launched the *Framework Act for Low Carbon Green Growth* with an investment volume of $83.6 billion. Similar to Clinton's NII, the bill shows the huge effort made by the state to support market-driven innovations in new network technologies. The region of Songdo is a Free Economic Zone with special tax incentives and location subsidies; not to mention public spending for transport, such as the high-speed rail system to Seoul. On top of that, the smart city attracts international capital with less restrictive labour laws than the rest of the country. 'New Songdo City' therefore, can be seen as a 'test bed for a form of urban life that is itself the product' (Halpern et al., 2013: 290). The city is designed to function as a demo for future life, in order to see who is willing to live and work in such a neoliberal environment. [11]

Similar to the Info-Cities of the 1990s, smart cities serve as new imaginary for actual cities, like Hong Kong, Toronto or Vienna – all of which are being enhanced by new network technologies to optimise daily life. Hence smart cities not only refer to the aforementioned test-tube cities, but also to 'the broader and far more consequential drive to retrofit networked information technologies into existing urban places' (Greenfield, 2013: 12). An illustrative example of this trend is IBM's smart city in Rio de Janeiro. In preparation for the FIFA World Cup in 2014 and the Sumer Olympic Games in 2016, information-processing capabilities were installed throughout the city and connected by a computer network, which is controlled from a central Intelligent Operations Center (see Singer, 2012). Initially designed to forecast floods and related emergencies, the system has been expanded to coordinate a wide range of urban policy issues – such as 'pacifying' Rio's favelas with the support of real-time surveillance data. As is the case in Songdo, urban citizens herby become 'sensing nodes' (Gabrys, 2014: 32), in order to live, work and participate in a more peaceful, productive and efficient way. Smart cities work like centralised Internet-platforms: being a fixed node within the information network, the citizen – or should we say user – is the source of data and the subject of data-driven governance; whereas the control over and management of this data remains in the hands of privately owned IT-businesses (Greenfield, 2013: 83ff.).

Conclusion

In accordance with the urban vision of the 1990s, the smart city aims to banish the problems of the modern world by building an experimental playground for neoliberal governance. While in the early days of the Internet the city came into the net, in order to structure the newly formed data space, today the net comes into the city, in order to provide the necessary data to govern it. This sort of optimisation, based on networked information technologies, follows the old dream of the functional city, which is divided into neatly arranged and easily manageable zones of activity: work, leisure, transport, home, etc. Both the info-city of the 1990s and the smart city of today are considered to be ideal spaces of information, designed to integrate computational systems with architectural knowledge, in order to overcome the deficiencies of confusing urban settings. However, this escape from reality merely repeats the quietist attitude of early

cyberculture: 'Rather than engaging in decisive political action, we defer and extend action: we are arguably forever searching, but never finding' (Chun, 2015: 290). In order to overcome this situation, we need to envision new modes of organisation beyond the predominant network model. So by drawing a line from the early days of network building to today's networked reality, it becomes clear that the digital space is itself the subject of constant struggle and renegotiation. Consequently, the historical debate about the informational city provides us with an alternative line of thought: What if we think about the networked sphere as an open space rather than an enclosed one? Instead of a perfectly organised urban environment, where everything and everyone is already in place, the digital landscape might actually resemble a web of spatial ramifications and social relations, inviting the user to explore and spatially experience his or her social environment:

> In New Babylon, social space is social spatiality. Space as a psychic dimension (abstract space) cannot be separated from the space of action (concrete space). Their divorce is only justified in a utilitarian society with arrested social relations, where concrete space necessarily has an anti-social character. (Nieuwenhuys, 1974)

As Dutch painter and situationist Nieuwenhuys tried to make clear more than thirty years ago, it is the unknown, rather than the always already known, that dreams are made of. [12]

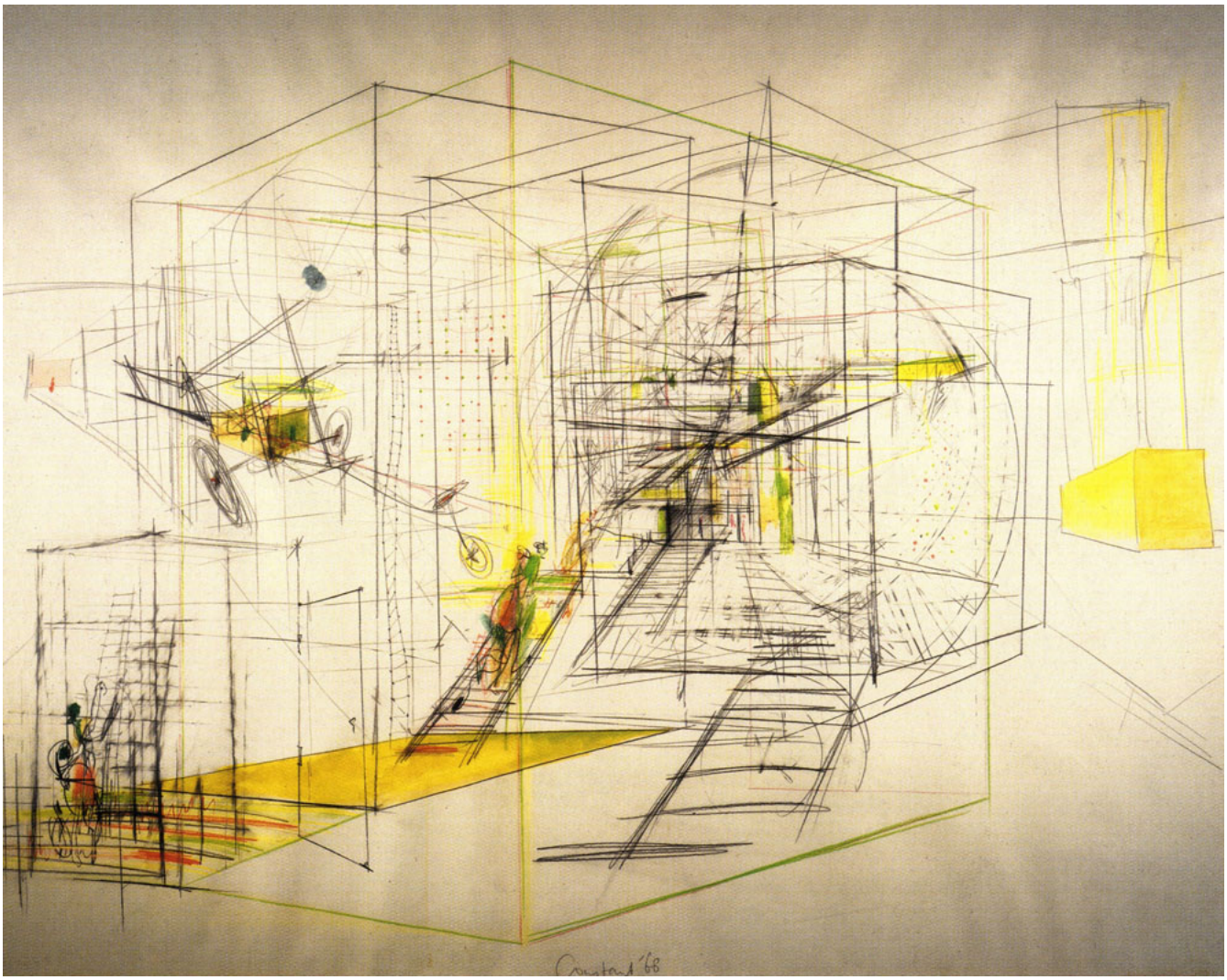

Figure 7. Constant, New Babylon. Sketch for a mobile labyrinth (1968)

Constant's dream of a modular city is the anarchic counter-concept to the modernist ideal of a structured and predetermined urban space, best exemplified by Ebenezer Howard's *Garden Cities of Tomorrow* (Howard, 1902). Instead of building a city from scratch, Constant simply wants to add a new layer on top of the existing one: 'Rather than demolish the old world to build a *radiant city*; rather than build a *garden city* on greenfield sites, Constant cantilevers new spaces up above, leaving both city and countryside untouched' (Wark, 2011: 138). These spaces are constantly remodelled living areas, provided with social facilities for everyday use such as libraries, schools and shops. Together the spaces form a huge network of linked sectors, which can develop and expand in every direction. Hence, vertical layering is accompanied by a horizontal networking. But unlike today's neoliberal network model, there 'are no *a priori* links between anyone' (Nieuwenhuys, 1974). For Constant, city planners should not accept existing social relations as given, thereby dividing urban space according to these relations; instead, they should embrace 'disorientation that furthers adventure, play and creative change' (Nieuwenhuys, 1974). *New Babylon* is heterogeneous and complex, a transversal superstructure, made possible by a new technological infrastructure. As such, it yields 'an architecture of duration, of thresholds, of collaborative place-making' (Wark, 2011: 140). Constant seeks to preserve, enhance and intensify the existing space, rather than leaving the dysfunctional city with its population behind. In order to do so he argues in favour of computer and network technologies. However, and in contrast to Smart Cities today, New Babylonians have full control over these technologies: far from remaining passive within a postmodern world, they use technologies to create space, whose structure changes frequently and makes possible a new 'experimental collectivism' (Nieuwenhuys, 1974).

Biographical Note

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Notes

[1] Of course computer networks are much older than the WorldWideWeb, going back to the ARPAnet of the 1960s. Nonetheless, it was not until the introduction of the WWW in the early 1990s with its graphical user interface that users began to flock to the Internet.

[2] The organisational principle of the city, whose walls were supposed to protect the citizens against floodwaters, are part of our cultural memory since the Neolithic (Macho, 2009). In this sense, it is hardly surprising that in the face of the 'digital flood' the image of the city was conjured in the 1990s.

[3] Hartmut Böhme even speaks of a 'third ontological layer' (*'dritte Seinsschicht'*), which emerges in addition to the first (nature) and second (civilisation) layer (Böhme, 1999: 315).

[4] Mitchell's idea to represent the *City of Bits* by the visual structure of urban spaces goes back to Kevin Lynch (Lynch, 1960).

[5] Certainly Dieberger was not the first one who made use of this approach. From 1988 to 1991 media

artist Jeffrey Shaw created an interactive video installation, employing urban knowledge: In *The Legible City* users were able to navigate through a virtual city by means of a stationary mounted bicycle. Instead of house fronts, the cyclist went by letters, words and whole sentences, so that each time an individual narrative and interpretation of the legible city originated (Grau, 2004).

[6] The North American Freenets (in Cleveland amongst others) of the 1980s were conceptualised as open information and communication networks, in order to support local communities: 'These community networks [...] are intended to advance social goals, such as building community awareness, encouraging involvement in local decision-making, or developing economic opportunities in disadvantaged communities' (Schuler, 1994).

[7] In opposition to the concept of cyberspace as a virtual parallel space, the artistic, cultural and hacktivist practices in the context of digital cities sought to implement digital technologies within existing urban spaces. The proliferation of so-called 'social media' has precisely proven this approach to be right: it is not the parallel universe of a virtual reality but rather the net as a web of social relations that has gained significance today.

[8] The term 'interface' originated in natural sciences and depicts the surface forming a common boundary among two different phases of matter. The preposition 'inter' stands for 'in-between' and the Latin word 'facies' for 'appearance.'

[9] The report was finally approved by the European Council at its conference in Corfu on the 24th and 25th of June 1994 and lead to an action plan in order to realise the recommendations made by the report.

[10] Pre-planned cities built from scratch, such as Brasilia, Canberra or Islamabad, have been around since the 1960s. Nonetheless, Songdo represents a new urban concept called *Aerotropolis* (Lindsay, 2011), which is – simply put – a city built around an airport, rather than sticking an airport on an existing city. Songdo is linked by a 7,4-mile bridge to *Incheon International Airport*, competing with other gateways in the region, in particular Shanghai and Dubai.

[11] In this sense, new urban zones, such as New Songdo City, but also Shenzhen or Astana, serve as the neoliberal 'double' for actual cities like Seoul, Hong Kong or Almaty (cf. Easterling, 2014: 48ff.).

[12] Constant himself indicates that 'New Babylon is not a town planning project, but rather a way of thinking, of imagining, of looking at things and at life' (Nieuwenhuys; quoted in Wigley, 1998: 62).

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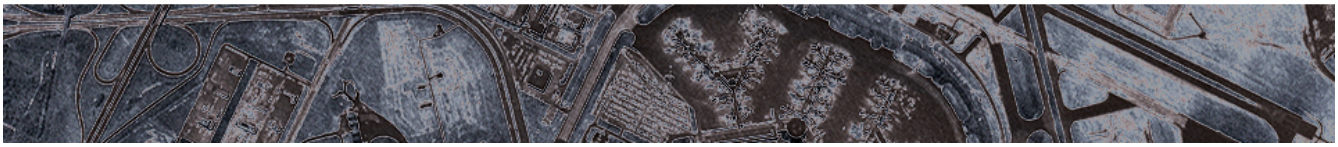

FCJ-214 Visions of Urban Informatics: From Proximate Futures to Data-Driven Urbanism

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Abstract: Urban informatics is positioned to offer unique insights into complex urban processes through use of big data and pervasive computing. This paper examines the rise of urban informatics as a field of expert urban knowledge, with a focus on the particular visions and epistemologies of the city embedded within the field. By exploring its emergence over the past decade, and reflecting on connections with previous eras of urban computing, the article explores questions about the kind of city that is occupied, resolved and reformed by urban informatics and associated lab-style data sciences.

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Introduction

Urban informatics, the nascent field that took as its subject the urban contexts of increasingly connected, smartphone-enabled citizens, is ten years old. Armed with tools of digital experimentation, data science, and design, equipped to decipher and decode complex urban environments, the field is increasingly positioned as a vital contributor to the contemporary urban sciences. The proliferation of distributed computing throughout our cities presents seemingly unlimited opportunities to explore and interrogate the workings of the city using novel methods of information retrieval, analysis and visualisation.

Reflecting this opportunity, investment in urban informatics research capability is growing. In 2012, three significant research institutes focused on establishing city-focused data sciences capabilities were created in New York alone, [1] joining existing groups such as Queensland University of Technology's Urban Informatics Research Lab and the MIT SENSEable City Lab in promoting the applications of urban science and informatics to improving cities. As well as these urban informatics labs, there are now hundreds of initiatives, platforms, specialist interest groups and government investment programs that are actively pursuing novel data-driven approaches to understanding the fabric of urban spaces, with a view to generating better outcomes for our cities. Predictive analytics, machine-learning tools, open APIs (application programming interfaces), crowd-sourcing platforms, distributed sensors associated with the Internet of Things, programmable screens and novel sensing apps are but a small selection of tools

developed with the intention of improving the functional performance of cities and with it, everyday conditions of urban liveability. These tools allow urban informatics to claim the city as an 'urban laboratory' (Karvonen and Heur, 2014), a territory utilised for the purposes of practical experimentation, prototyping new solutions, and designing opportunities for new ways of living in the city.

While a relatively new entrant to the field, the Center for Urban Science and Progress (CUSP) has bold ambitions to become the world's leading authority in urban informatics. Led by New York University and NYUPoly, CUSP promotes a new model of public-private education that seeks to create real-world applications of urban data to help solve a wide range of urban challenges. With an annual operating budget of $70m, its partners include the City University of New York, Carnegie Mellon University, University of Toronto, University of Warwick, Indian Institute of Technology Bombay and technology leaders IBM, Microsoft and Cisco. Like other urban informatics laboratories CUSP maintains a commitment not only to research and education, but also to 'real demonstrations of new tools and new solutions' (CUSP, 2013: 9). For CUSP the city of New York is claimed as both 'laboratory and classroom'. Its website describes its approach to urban informatics as one that 'observes, analyzes, and models cities to optimise outcomes, prototype new solutions, formalize new tools and processes' thus developing new expertise and experts in the field (CUSP, n.d). [2] The use of computer science in urban governance and decision-making is by no means completely novel (Bettencourt, 2013; Lee, 1973; Townsend, 2013), nor is it confined explicitly to the field of urban informatics. The more recent rise of 'big data' and smart cities as powerful urban innovation agendas (boyd and Crawford, 2012; Kitchen, 2011), along with high profile investments into new entities like CUSP, has helped to propel the field forward. Ten years after the first urban informatics lab was created at QUT in 2006, the same year that geographers gathered in the UK to discuss the promises and perils of urban informatics, we can use the span of a decade to reflect on the challenges and opportunities of how we 'compute the city'.

As a uniquely hybrid discipline, variously defined but necessarily spanning an interest in cities on the one hand, and information science on the other, today's growing interest in the potentialities of urban informatics continues to surface old tensions that have continually haunted attempts to quantify and measure complicated, dense and unruly urban spaces. As is well known, previous eras of urban planning confronted major tensions in the measurement of cities, leading to a loss of confidence in the assertion of 'general' or 'comprehensive' theories of the city, reliant on quantitative models alone (Lee, 1973; Townsend, 2009, 2013; Batty, 2013: 272). This recognition of failure in the ability to construct useful scientific models of the city stemmed from a realisation that computer models were not capable of grappling with the daunting complexity of cities (Lee, 1973; Batty, 2013: 272).

And yet today, a potent combination – involving steady advances in computing modelling, simulation and predictive analytics relating to the workings of the city and its subsectors (transportation and land-use planning, for example), and massive amounts of machine-readable data associated with rapid personal device uptake and an emergent Internet of Things – means we need again to confront the possibilities of a 'science of cities' (Batty, 2013; Townsend, 2015; Bettencourt, 2013), one that is now more confident in its contributions to the 'real world' contexts of urban design, planning and governance. Does this confidence, this upswing of interest in and support for urban informatics, mean we have overcome historical limits to the objectification of cities? Or, put another way, what responsibilities does urban informatics bear, in this age of pervasive data and digital disruption, when it attempts to construct a domain of urban expertise that spans both the information sciences and the urban condition? Such questions are not easy to answer,

but this should not stop us from asking them.

This paper reflects on the rise of this field over the past decade, and traces the territories it has claimed, along with the kinds of urban spaces rendered through its disciplinary associations. The intention is to advance a better understanding of how the city has been 'computed' in recent years by those attuned to the increasingly central role of digital computing in urban contexts. This shifts the focus somewhat, away from questions about how 'informatics', big data, or even 'smart technologies' might be *applied* to urban problems, by looking in more detail at how 'the urban' is constructed as a space to be occupied, resolved and reformed by informatics and data science laboratories. Where information science produces its own particular map of the territory (we ought to call it a data visualisation), here we retrieve a sometimes-unfashionable idea that how we *imagine* the city can also help shape what we hope we can gain from our devices.

It is worth noting that this paper is not so much a detailed assessment of the possibilities of urban science today, something Townsend has been investigating in recent years (2015), though it does attempt to capture the particular claims of urban informatics as an emergent discipline. While urban informatics is a young discipline, the shifts and divergences that have taken place within the field over the past decade deserve critical attention. By considering urban informatics in this way, it is hoped that the lessons from previous debates concerning the place of computing in the city might play a part in the way we might consider the present moment; opening up critical territories relating to how the spaces of the urban are governed, experienced, shaped, lived, marketed and imagined into being.

Modern urbanism is ever-inflected by a philosophical conception of the city based on an idealised Athenian polis and its notion of the agora. 'The city' as Jameson (2005: 5) reminds us, presents itself as the 'fundamental form of the utopian image'. It is this conception that continually nourishes us to think of the modern city according to a model of the antique city, the ideal city and the rational city (Lefebvre, 1996: 98). While there is a great deal of attention towards, and investment in, new processing tools for sensing and visualising urban complexity, we need to re-assess the extent to which contemporary attempts at digitally-driven urban engagement may be subject to the same vulnerabilities as have plagued historical modes of urban utopianism. How do we counter the endemic utopian tendencies of the urban with a rational assessment of what our contemporary computational capacities might offer the difficult work of necessary urban reform? And likewise, how do we counter the stubborn reliance on *technics* as solutions to complex socio-spatial challenges? As urban informatics matures as a discipline over the coming years, such questions won't necessarily find easy answers, but they will surely require some attention.

What is Urban Informatics?

> The increasing ubiquity of digital technology, internet services and social media in our everyday lives allows for a seamless transitioning between the visible and the invisible infrastructure of cities: road systems, building complexes, information and communication technology, and people networks create a buzzing environment that is alive and exciting. (Foth, Choi and Satchell, 2011: 1)

Let's begin with some definitions. Howard Rheingold is thought to have christened the field, writing in a 2003 article entitled 'Cities, Swarms, Cell Phones: The Birth of Urban Informatics' in which he reviews the work of 'urban informatician' Anthony Townsend in straddling the co-evolution of cities and personal media

(Rheingold, 2003; Foth, 2009a; McCullough, 2013: 196). [3] An Urban Informatics Colloquium held in December 2006 at the University of Durham, UK, explored contemporary intersections between urban theory and social informatics, but offered no single definition (see Ellison, Burrows and Parker 2007: 785). Williams, Robles and Dourish then defined urban informatics through its placement at the 'intersection of computer science, design, urban studies, and new media art' (2009: 2). McCullough has more recently ventured a useful definition of urban informatics as a field that seeks to 'collect, share, embed, and interpret urban infrastructural and environmental data' (2013: 196). For Foth, Choi and Satchell (2011), 'driven by curiosity, initiative and interdisciplinary exchange' urban informatics is understood as:

> The study, design, and practice of urban experiences across different urban contexts that are created by new opportunities of real-time, ubiquitous technology and the augmentation that mediates the physical and digital layers of people networks and urban infrastructures (2011:4).

These authors, associated with the first urban informatics lab of its kind established at the Queensland University of Technology in 2006, locate their focus as the 'qualities of place, technology, and people in urban environments' (see for example Foth, Choi and Satchell, 2011: 2). Inter-disciplinarity is key, then, and so, too, are points of intersection between the physical, or 'hard' infrastructures of the city, and the 'soft' informational spaces of ubiquitous network computing; sometimes also described as the emergent 'hybrid' spaces of augmented, mobile media (Goggin, 2006; de Souza e Silva, 2006), post-desktop computing, wearable devices, and the Internet of Things (ITU, 2005).

But while the possibilities of the digitally-instrumented city have attracted attention from a wide variety of disciplines, urban informatics asserts itself not only as an *object* of study, but also a mode or ethic of *practice*. Thus, to Anthony Townsend (2009: xxiii), urban informatics constitutes 'the collection, classification, storage, retrieval, and dissemination of recorded knowledge' both *in* and *of* a city. As an *object* of study, urban informatics articulates the space of the city as a complex informational system; as a *practice* it advances the new capabilities and uses of distributed, ubiquitous technologies in order to better understand and indeed improve the experience and performance of the spaces and places of the city. The work undertaken within urban informatics laboratories has remained highly practice-oriented, with technology trials and app development and design used primarily as tools for research into the impacts or uses of digital technologies in urban contexts.

Where does UI come from?

Urban informatics itself is a relatively new field of practice, however it draws from a range of historical influencers and disciplinary alignments, spanning the rise of informatics, ubiquitous computing, human-computer interaction and participatory media. Informatics emerged in recent years as a highly applied science, generally defined by the gathering, use, retrieval, and visualization of information. As Verhoeff has noted, informatics is always *both* information and its processing (2013: 140). [4] Studies of the disciplinary divergences of the field (for example, Rosenbloom, 2013) have traced close alignment to the field of biology (bio-informatics), with more recent applications focusing on the applications of big data to newer domains, including neuro-informatics, energy informatics and business informatics. Across many of these fields, informatics is known to introduce an ethos of practical experimentation and utility.

Informatics also predates the focus on data science applications. During the early 2000s, it was more

closely associated with information and communication technologies (ICTs), and attempts to understand the practical contexts of computer usage. This gave rise to particular fields of community and social informatics. For example, Guerstein advanced the term 'community informatics' to challenge the device-centric nature of much digital divide literature in the early 2000s, in order to firmly situate 'the design and implementation of ICT systems in their community and social context' (2003). This helped shift the emphasis within studies of Internet uptake towards the everyday contexts of 'effective use' of ICTs, rather than simply counting who was connected and who was not. Kling (2000: 246) championed the role of 'social informatics' as the 'interdisciplinary study of the design, uses and consequences of information technologies that takes into account their interaction with institutional and cultural contexts.' As a field, it 'defined a topic and set of fundamental questions, rather than a family of methods' (Kling 2000: 246). Early research into social informatics, undertaken as early as the 1970s and 1980s, focused on organisations as major sites for studies of the impacts of computerisation on work processes and organisational planning (see Kling, 2000).

To Foth, who has championed the need for a specifically *urban* informatics, and helped to delineate the new field through his edited collection, the *Handbook of Research into Urban Informatics* (2009a), the term 'informatics' has been closely associated with studies of information processing and, via social informatics, the social contexts of ICTs. It offered a useful term to be co-opted as a way to likewise shift focus away from the physical hardware associated with urban computing and digital urban infrastructure, and towards the 'softer aspects of information exchange, communication and interaction, social networks, and human knowledge' (2009: xxix). Of course, information processing in cities is not unique to the era of digital disruption, or indeed to the rise of urban informatics, but has long been claimed an 'age-old function of cities' (Mumford, 1961; Mitchell, 1996; Graham and Marvin, 2001). As Townsend wrote in the same collection: 'Taking a long view of urban informatics, the simultaneous urbanization and global economic integration we are currently experiencing can best be seen as *a refinement of the city as a system for information processing*.' (2009, xxiii; my emphasis).

Nevertheless, there is something particular about the contemporary trajectory of information processing in the city that sets itself apart from previous eras. For Townsend:

> [I]t seems that after 50 years of incubating digital information technologies on the desktop, we are now at the point where they are to become inextricably woven into the everyday social and economic life of dwellers in every city on the planet... Like Frankenstein's monster, the physical fabric of cities is waking up and becoming aware of itself (2009: xxiii-xxiv).

A sense of the physical fabric of cities 'waking up and becoming aware of itself' was for many years somewhat speculative, and drew on anticipatory projections by architectural futurists such as William J. Mitchell. In *City of Bits* (1996), Mitchell noticed the way that more and more of the instruments of human interaction were becoming miniaturised, dematerialised and cut loose from fixed locations. It was a shift, he believed, as significant a reform to the urban fabric as the construction of Haussmann's nineteenth century Parisian boulevards (3). But unlike Haussmann's grid, the 'invisible city' of the twenty-first century would, Mitchell argued, be shaped more by the a-spatial logic of networked data which would 'turn classical categories inside out, and [would] reconstruct the discourse in which architects have engaged from classical times until now' (1996: 24). This 'city of bits' would not be rooted to any definite spot on the surface of the earth, and would be shaped by connectivity and bandwidth constraints, rather than land

values or physical accessibility. In this model, places would be 'constructed virtually by software instead of physically from stones and timbers, and they will be connected by logical linkages rather than by doors, passageways, and streets' (1996: 24). For Mitchell, the spatial syntax of networked information disclosed a new spatiality: the widespread digitisation of material urban spaces underscored the need for 'imagining and creating digitally mediated environments for the kinds of lives we will want to lead and the sorts of communities we want to have' (1996: 24).

The speculative quest for appropriate metaphors to describe the radical *strangeness* of these 'cities of bits' has been widespread, and certainly not limited to the work of urban informaticians: from the 'real-time city' (Kloekl and Ratti, 2011), the 'sentient city' (Crang and Graham, 2007), 'the internet of things' (ITU, 2005), programmable cities (Kitchin, 2011), pervasive urban computing (Kindberg, Chalmers and Paulos, 2007) to the notion of 'everyware', what Greenfield (2006: 1) calls a 'vision of processing power so distributed through the environment that computers effectively disappear', referencing the ideas of Mark Weiser (discussed shortly). For those interested in the place of computing in the city, it became clear that the sense of cyberian apartness that once distinguished the speculative interest in virtual 'cyber cities' of the 1990s, when the Internet was still just something you 'went to', was disappearing. Rapid innovations in computer processing power, including miniaturization and advances in micro-processing, would, during the 2000s, ultimately undermine any sense of material transcendence. Rather than McLuhan's abandoned cities, left as 'cultural ghosts for tourists' (1969: 12), ubiquitous access to the Internet would become an increasingly *infrastructural* condition through which many interactions *within* the urban world would take place. As Mitchell (1999) may have put it: 'Urban life, Jim, but not as we knew it'.

Urban informatics emerged to respond to this increasingly mobile, pervasive nature of computing, ready to claim as its subject the everyday urban conditions of ubiquitous computing. Where Sassen's global cities analysis (2001) referred to the structural tendency for informational processes to *agglomerate* in global cities, the focus for urban informatics shifted to the material spaces of information *diffusion*. For Dan Hill, in a seminal 2008 essay 'The Street as Platform', it was necessarily through the scale of a 'typical high street', that we should best understand the informational spaces of urban life. Sketching out a series of everyday episodes and localised interactions occurring in a nameless street, Hill paid close attention to the kinds of invisible data these interactions were producing, at once 'collective and individual, aggregated and discrete, open and closed' (Hill 2008: para 4).

Thinking about streets as 'urban interfaces' reflects ideas from the field of Human-Computer Interaction (HCI), particularly where it has pushed for new interaction experiences that encourage people to use their computers in novel ways (see Foth et al., 2014). HCI researchers and designers, working within and beyond the realms of the computer sciences, have actively pursued new interaction design opportunities that pay close attention to the social and psychological contexts of computing (see Dourish, 2001: 61; also Suchman, 1987: 10). Arguing for a 'more profound basis for the relative sociability of computer-based artifacts', HCI proponents such as Suchman (1987) have advanced the notion of the computer as a social object. Drawing from the observational techniques and practices of HCI, urban informatics has in turn advanced the need for new interface design possibilities, taking on the scales of streets, masterplans, mobile devices, sensor and Bluetooth technologies and everyday wayfinding as necessarily integrated fields of design practice.

For urban informatics, the everyday urban spaces of mobile computing have remained a key focus. This has helped distinguish it from other cognate fields of study, such as locative or mobile media (Goggin,

2006; de Souza e Silva, 2006), or computer modelling or simulation (Batty, 2013). As Foth put it, this embedding of informational technologies within everyday spaces allows for the 'more human elements of communication and information exchange' to come into focus, not simply 'specific technologies or devices' (Foth, 2009a: 2), but their contexts of use.

This links the field strongly with the preoccupations of ubiquitous computing, or 'ubi-comp', a term coined by computer scientist Mark Weiser, who led a team at Xerox Palo Alto Research Centre (PARC) in the late 1980s. Weiser's influential 1991 paper published in *Scientific American* called 'The Computer for the 21st Century' outlined a new 'ubiquitous' or 'pervasive' model for personal computing that would place the computer in the foreground of our attention. Describing the potentials of 'experimental embodied virtuality' (Weiser, 1991: 81) that would 'take into account the natural human environment and allow the computers themselves to vanish into the background' (89), Weiser anticipated a shift away from solitary, immersive computing interactions and their 'centripedal forces', to much more socially-integrated contexts (89). This orientation towards social context within ubi-comp provided a conceptual scaffold for urban informatics, and set up conditions for active interdisciplinary exchange. As Weiser advised in a keynote lecture given in 1994: 'Start from arts and humanities: philosophy, phenomenology, anthropology, psychology, postmodernism, sociology of science, feminist criticism, your own experience' (slide 10, in Bell and Dourish, 2011: 14). In other words, place ubi-comp within a broader disciplinary conversation with science and technology studies, socio-cultural anthropology, and media and cultural studies (see Bell and Dourish, 2011: 45). To 'get computing out of the way', is not only to make computing physically invisible but rather to let it play a role in agendas that originate elsewhere.

Taking on this stance, practitioners of urban informatics are often working as urban activists seeking to reshape the urban environment. Honing in on street-level data provided a means to reform the very fabric of the 'urban interface' itself (Hill, 2008). For Townsend, the smartphone is claimed as a platform 'for reinventing cities from the bottom up' (2013: xiv). It is the potential for widespread citizen-centric participation in the reform of the city that has been pursued as one of the greatest benefits of mobile, ubiquitous access. As compared to the stance of more 'objective' urban science centres such as work originating out of UCL's Centre for Advanced Spatial Analysis (CASA), urban informatics has tended to pursue an urban reform agenda through a highly anticipatory set of claims about both its object of study – the city as a space for information processing, the spaces of the city filled with intelligent sensor devices – and the relative potentials of pervasive, networked computing to reshape the city towards more open, participatory models of urban governance and decision making. In other words, the city of urban informatics has been conceived as an agent of change, its potential for transformation (good or bad) closely linked to the rate and scale of instrumentation.

This particular anticipatory orientation is worth exploring in more detail. When assessing the research outcomes and practices associated with urban informatics over recent years, it seems clear that many lab-style interventions and prototypes have served as provisional markers towards *potential*, preferred futures. Technology trials and research-led prototypes have tended to reinforce a fairly positive view of ubiquitous computing as enabling more open platforms for participatory engagement in planning and urban decision making (Paay et al., 2007; Wallin et al., 2010). They chart potential futures, but as research trials, experiments or prototypes, they also work outside of the mainstream institutions of traditional urban governance, with relatively confined and controlled measures of success. This can mean the wider complexity of achieving broader systemic change, where it might entail critically influencing wider

institutional regimes of decision-making, governance and investment, can figure as the messy work best left to others.

Urban App-tivism: Remake the City with Your Phone

For much of its short history, urban informatics has championed the idea of the mobile user as an interventionist agent of change in the city. The Urban Informatics Research Lab at QUT established in 2006, [5] has done much to advance urban informatics which it describes as a discipline that uses 'instruments for live surgery' to not only render the invisible visible, but to create a 'buzzing environment that is alive and exciting' (Foth, 2009b: par 2). One forum held in Australia in 2010 introduced the mobile phone user as instigating disruptive behaviours capable of activating new or hitherto repressed currents of citizen engagement. Here, a city 'decentred by the new fluidities of mobile communications' was envisioned as one operating more efficiently, thus 'encouraging greater opportunities for interaction' (Satchell, 2009: par 1). In this study, the city's capacity to become 'decentred' reflects the mobility of device users' communications patterns.

The SENSEable City Lab, a well-known research initiative located at the Massachusetts Institute of Technology (MIT), has for more than ten years championed the tools of urban informatics through lab-style interventions and technology experiments. The Lab founder, Carlo Ratti, has advocated the tools of urban informatics as capable of radically transforming the way we describe and understand cities. The Lab 'studies and anticipates these changes from a critical point of view', producing applications and graphic representations of 'real-time cities' whose dynamic data flows help illuminate complex urban behaviours (MIT, n.d.). These data visualizations, well known to many, have generated a visual palette through which to capture today's highly-informationalised urban spaces as porous, networked and globalised. One of its first projects, *New York Talk Exchange* (2008), illustrated the global exchange of information in real-time by visualizing volumes of long distance telephone and IP (Internet Protocol) data flowing between New York and other cities around the world. As the project site noted: 'In an information age, telecommunications such as the Internet and the telephone bind people across space by eviscerating the constraints of distance' (MIT, 2008a). Another early SENSEable City Lab project, *Real-time Copenhagen* (MIT, 2008b), [6] used mobile devices to track people's movements through the city, displaying the pulse of Copenhagen's *Kulturnatten* (culture night) as it unfolded in real-time. This project built on earlier work such as *Real-time Rome* (2006), [7] which similarly used mobile phones and GPS devices to collect the movement patterns of people and transportation systems and their spatial and social use of streets and neighbourhoods. *SmartBiking*, another Lab project implemented in Copenhagen during 2009, utilises a self-organizing smart-tag system to allow the city's residents to exchange basic information and share their relative positioning with each other (MIT, 2009).

Many of the SENSEable City Lab's software applications have depended on willing participants sharing their personal mobile use data in aggregate form. In return, users are encouraged to think of themselves as actively 'participating' in the production of new urban interfaces: interfaces not of physical surfaces, but of informational use. The work of the Lab has been overt in its attempt to not monitor mobile users through a kind of sinister, top-down urban surveillance, but instead encourage mobile users to think of themselves as actively contributing to the production of novel ways to 'picture' or 'make visible' their environments. The appeal of crowd-sourced data obtained through mobile devices and apps has been in the way it reveals what Hill (2009) refers to as the proximate 'soft infrastructures' of the city, the rich patterns of everyday

urban behaviours, and the complex, multi-layered networks which take in the various different socio-cultural, material and environmental natures of urban space.

Through these enhanced powers of observation, allowed through illuminations of networked GPS devices and sensors, practitioners have claimed the means to reveal that which was previously unseen. In this view of the urban scene, real-time cities are at once revealed and celebrated as objects of data flow and analysis, allowing for new affordances for urban change. As Carlo Ratti once pointed out, in discussion with Hill (see 2009: par. 11):

> [W]e're hardly going to change or destroy all these existing buildings and spaces anytime soon – urban form just doesn't change that quickly – but *the profound changes in the way cities feel and function may be in this internet-enabled informational layer*. (my emphasis)

While not always explicitly aligned to urban informatics, the claim that new digital platforms such as smartphones can be used to transform the way our cities are understood from a 'traditional' urban planning perspective has been quite widespread. Research undertaken by the Institute for a Broadband Enabled Society (IBES) at the University of Melbourne for example, claimed great potential associated with the shift from cyberspace to pervasive computing, in opening up 'new possibilities of social interaction in public spaces' while at the same time presenting 'new possibilities of appropriation of public spaces which challenge the status quo of urban planning theory' (IBES, 2009: par. 2). Where the Euclidian framing of geographic space was subjected to sustained critique for its simplistic organisation of complex spatiality, the use of ubiquitous computing has been widely celebrated as the 'vector of a new geography' (Holmes 2006). For Madera (2010, in Bettencourt, 2013: 10):

> What's different about the information age that has been ushered in by personal computers, mobile phones and the Internet is its ability to reshape the social organization of cities and empower everyday citizens with the knowledge and tools to actively participate in the policy, planning and management of cities.

In this way, ubiquitous technologies and sensors have been championed as a new kind of 'architecture of participation' (Williams, Roubles and Dourish, 2009: 4); a burgeoning field of 'read/write urbanism' (Greenfield and Shepard, 2007) in which traditional urban, social structures and governance methods could be radically reconstituted according to the 'techno-social assemblages' associated with the participatory cultures of networked mobile use. This orientation echoes architecture's fascination with cybernetics in the 1960s and 1970s, as exemplified within the work of studios such as Archizoom, Archigram and Superstudio (see Scott, 2007). These studios drew from the logic of cybernetic feedback loops to identify ways for citizens to play an active role in shaping the space they inhabit using 'non-plan' material architecture, proposing material interventions that were open, extendable and adaptable to changing patterns of use and activity.

Urban informatics has continued this activist focus on 'citizen centric' applications of urban technology. In recent years, opportunities for increased participation in city-making through digital technologies have been most closely associated with the rise of Web 2.0 technologies (Foth, 2011; Rheingold, 2002) – more so than traditional modes of urban participation in the form of, for example, citizen council juries or participatory urban planning forums. Where interest turned to the rise of user-led content creation, digital

social interaction using Web 2.0 applications was, for a time, widely seen to offer enhanced interactive and collaborative capabilities, not only within digital spaces (Munster and Murphie, 2009; Ang and Pothen, 2009) but for participatory democracy more broadly. New media advocates such as Pierre Lévy (2001), Henry Jenkins (2009), and Howard Rheingold (2002) helped to pioneer an appreciation towards the way networked experiences of online interaction might create new kinds of social co-ordination and 'collective intelligence' via exponentially increasing network links. In these contexts, once-passive consumers of media are transformed into active, content creating producers – once called 'produsers' (Bruns, 2007). Rheingold's *Smart Mobs* (2002) captured the radical potentialities posed by the ability of groups of people connected using mobile technology to meet each other at a particular location and time, generating spontaneous public protests or expressions of co-ordinated play. 'Participatory culture' as advanced by Jenkins (2009: 3) likewise described the radical cultural shift taking place, as online users adopted new practices of media consumption and communication that contrast dramatically with older notions of passive media spectatorship.

Aligned to this work, urban informatics championed the potentials of participatory media to reclaim 'traditional' urban spaces, and to reconstitute city contexts with the more exciting spaces of digital connectivity. Where non-networked spaces may have been subjected to 'traditional', 'top down' planning, digital spaces of urban interaction could, through the use of mobile devices, become much more 'buzzing and exciting'.

The Smart City: From Participatory Agora to Corporate Nightmare?

This hopeful orientation towards the potential for smartphone-connected citizens to reshape the city in more open, democratically-motivated ways appears to have waned in recent years. Once enthusiastic proponents of urban informatics have cautioned against the co-optation of platform technologies by corporate power, particularly in relation to the smart city. In 2013, Anthony Townsend, Adam Greenfield and Dan Hill each published their own 'manifestos' in which they spelt out their growing disillusionment towards the tech-enabled smart city: Greenfield's *Against the Smart City* (Greenfield and Kim, 2013) was written 'to bury the smart city not to praise it'; Dan Hill's essay 'On the Smart City: Or, a Manifesto For Smart Citizens Instead' (2013) implored readers to beware of technology control systems dressed up as smart, sustainable urbanism, and called for a renewed focus on 'smart citizens', via the computational capacities of social media and smartphones. For Townsend, much of what has driven the innovative capabilities of digital platforms – openness, interoperability and innovation – is at risk of being left out of a data-driven urban innovation agenda, as technology vendors sell proprietary platforms that lock in their customers and expose them to inappropriate risk.

Referring to Jane Jacobs' framing of city as a complex web of interactions, Townsend warned that the framing of smart cities as proprietary technology platforms risks denuding them of the vitality and innovation that will be needed to serve their cities, and their citizens, well. Suspicious of the 'seductive pitch' being crafted by the giants of the technology industry who see massive financial opportunities to be gained in the funding of smart infrastructure services, Townsend (2013) has set out to put an end to the domination of corporate visions about the future of cities. He asks his readers to stop asking how technologies are going to change the world, and instead ask 'how we are going to use our technologies to create the kinds of places we want to live in?' (Townsend, 2013: 17). Hill has remained positive about the

potentials not of smart cities but of smart citizens, powered by social media: 'We see social media-driven activism finding a foothold in the essentially ancient urban form of the square – the two work together, with the dynamics of social media manifesting themselves in these relatively open urban forms' (2013).

Ambivalence towards the smart city is by no means confined to these authors. Yet, their scepticism is noteworthy because it was these authors who first did so much to advocate for urban informatics as a mode of urban intervention and digitally-enabled urban practice. If ubiquitous, 'post-desktop' mobile computing is not as empowering as previously thought, what changed? Ten years after the field first began to claim a territory for action, intervention and change, it is worth reflecting on this. Can we now reflect, for example, on how successful smart phones have been in disrupting established urban planning regimes? In places with ubiquitous access to broadband, do urban environments exhibit trends towards different kinds of planning or governance regimes, comparative to those where effective use or access is low? Is there evidence of a correlation between device uptake and more participatory decision-making in cities? If smart cities are a worrying thing, as those such as Greenfield, Hill and Townsend have argued, did urban informatics perhaps promise too much?

Critical Appraisals

Locating the relative significance of technology disruption with the wider transformative dynamics of the urban condition has never been easy. Graham and Marvin, in their seminal work *Splintering Urbanism* (2001), highlighted this as a stubborn conceptual challenge. The problem is not just that technologies are valorised, their ability to 'impact' or 'transform' spaces repeatedly over-emphasised, but that urban spatiality itself is poorly understood. As a generation of urban geographers have come to see it, spatiality too often features as the 'empty area' *within which* social, networked relationships are formed, in which action takes place (see Graham and Marvin, 2001: 55; Soja, 2000; Massey, 2005; Lash and Urry, 1994). The instrumentalist view accords technologies of networked communication undue transformative power over space. With an emphasis on 'making the invisible visible' through new computational modes of visualisation and interaction, the risk is that pre-existing modes of urban social interaction are rendered somehow redundant, or certainly less visible.

Urban informatics has not been immune to a criticism insistent on the historical and conceptual challenges attached to urban spatial production and representation. In an essay from 2009, Williams, Roubles and Dourish, argued that many practitioners of urban informatics appeared to approach the urban environment as 'no more than an appealing design resource' and did little to address the characteristics of specific urban contexts. They argued:

> [d]esign efforts in urban informatics might best be understood as technological responses to the conditions of city life. These design values systematically favor an interpretation of the city that, consciously or unconsciously, constrains how we think about the city (2009: 2).

The authors blamed, in part, a tendency to reassert a kind of moral coherence to the city that had long been unfashionable in urban sociology. The urban imaginary embraced by the field most resembled, they argued, turn-of-the-century assumptions about the metropolis associated particularly with the work of the Chicago School, including those such as urban sociologist Lewis Wirth. This had assumed the urban form as an ideal type, or privileged basis from which to discern broad or universal claims about modernity and

society (Williams, Roubles and Dourish, 2009: 1).

This deductive method of urban sociology, seeking as it did a moral and replicable coherence to the city, was widely refuted during the radical urban unrest experienced across western cities in the 1960s (Soja, 2000: 96-7), a period that prompted the critical re-evaluation of the idea of the city as it had previously been conceived. As Crary has argued, urbanism at this time 'collided with that moment in capitalism when the rationalisation of built space became secondary to problems of speed and the maximisation of circulation' (cited in Scott, 2007: 261). The legibility of the [Western] city reached 'the threshold of oblivion' (cited in Scott, 2007: 261), as the specific spatial form of the city gave way to a mode of capitalist development (urbanisation) that was anti-territorial, or certainly not wedded to a particular ecological or spatially-confined order (Castells, 1977).

This prompted Lefebvre to declare that 'the city no longer corresponds to a social object' (2003: 57). Analysis of urban spatiality would require new conceptual tools, recognising the processes shaping the production of the built environment as now multi-scalar and generalised – something more recently discussed in the terms of 'planetary urbanisation' (Brenner, 2013). Concerned with what he saw as an emergent 'science of space', Lefebvre argued that abstracted conceptions of spatiality risked relying on old 'fixed myths of the city' prone to 'fetishising space in a way reminiscent of the old fetishism of commodities, where the trap lay in exchange, and the error was to consider “things” in isolation, as “things in themselves”'. Thus, 'instead of uncovering the social relationships that are latent in spaces... we fall into the trap of treating space “in itself”, as space as such' (Lefebvre, 1991: 90). This is why Lefebvre would write of the city as either a historical phenomenon (as in the mercantile city or the industrial city), or an image or representation that is only ever partial or, indeed, ideological (2003: 57).

Globalised processes of urbanisation would thus call into question the validity of idealised visions of the 'rational city' (Boyer, 1987). Post-war modern planning – in holding on to the potency of 'the city' as an ideal and replicable type – would ultimately be viewed, in retrospect, as somewhat tragic in its over reliance on the urban spatial form as a basis from which to alleviate social ills, seeking to reform or renew built environments while leaving social relationships and contexts intact (Tafuri, 1976: 12; Boyer, 1996: 21; Harvey, 2000: 196). The problem of 'fixing' the spatial as a sphere outside of time and historical enactment is widely known. Instead of treating space as empty 'containers for action', the effort has been to instead to focus on the urban sphere as a *process* rather than primary object of spatial analysis (see Massey, 2005; Wachsmuth, 2014).

These are stubborn conceptual challenges that the field of urban informatics can’t easily sidestep. In particular, the challenge for the field is to adequately account for the range of contextual spatial relations within which device-enabled mobile citizens interact – even if simply to acknowledge that a partial representation is all that is valid. The 'everydayness' of urban streets doesn’t mean they are simpler or more neutral backdrops for intervention. Likewise, there is perhaps much to learn from previous historical challenges associated with the enactment of progressive urban movements. For Bell and Dourish (2011), there has been a tendency within ubi-comp to focus on 'horizon technologies', which has renders 'invisible' the here and now, allowing researchers and technologists to absolve themselves of responsibility for the present, or, indeed, the recent past:

> [T]he problems of ubicomp are framed as implementation issues that are essentially someone else's problem, to be cleaned up afterward as part of the broad march of technology or to be solved by savant children (Bell and Dourish, 2011: 22).

Bell and Dourish, writing on what they have called 'the mess and mythology of ubiquitous computing' (2011), have picked up on a persistent focus on the 'proximate future'. Instead of advancing more and more 'mythology' associated with a proximate technological future, they ask, what about dealing with the messiness of everyday life? Their question feels like an appropriate one for the field of urban informatics. There may be a great deal of *potential* solutions, but how do these fare against the potential threats associated with widespread data-driven techniques of quantification, surveillance, and mass observation? How might a critical urban informatics emerge within a data-driven era of urban innovation?

Future Challenges: Synoptic Urban Sensing, Vertical-Integration and Critical Interdisciplinary Dialogues

A more governance and policy-focused discipline has been emerging in recent times, dedicated to the practical applications of urban data to improve predictive analytics engines and machine learning tools, which returns us to the establishment of CUSP. CUSP uses municipal city data as the basis for predictive modelling to guide city decision-makers. In many respects its creation signals a significant shift away from the participatory, citizen-centric ethos that has guided the experiments and interventions of urban informatics over the past few years.

Unlike many existing trials and interventions that have tended to operate at the level of a research trial or prototype, CUSP has a memorandum of understanding (MOU) with the New York City government, allowing its researchers and data science students to access government records. Its research, in the form of software and analytics, is designed to be taken up by government employees, and support the work of public agencies. Where pre-existing urban informatics labs have tended to operate through localised crowd sourced platforms and trials, CUSP has adopted the 'synoptic' lens of big data analytics. As scientists from CUSP have noted, a central task is to document and understand the 'pulse of the city', spanning mobility, energy use, communications, and economics, undertaken to both 'define the normal state against which anomalies can be judged and to understand how macroscopic city observables emerge from the aggregate behavior of many individuals' (see Dobler et al., 2015). This includes the use of astronomical techniques to analyse the dynamics of city lights, and applying physics to the study of urban phenomena and human behaviour. Researchers at CUSP have also harvested building energy data released through open data channels and combined this with the use of hyperspectral imaging and broadband infrared to generate new ways of 'seeing' the city, capturing information such as energy usage through novel data science techniques (see Dobler et al., 2015; Kontokosta, 2012). The ambitious 'quantified community' program involved the creation of data- and sensor-enabled urban neighbourhoods in New York City to promote the use of data to support urban planning and design (Kontokosta, 2015). Likewise, energy benchmarking data sourced from the NYC government has been used to create a predictive benchmarking tool for energy performance monitoring (Kontokosta, 2012). These tools are developed with the objective of supporting the city's goal of reducing carbon emissions by 80 per cent by 2050.

The use of large-scale datasets to support data-driven urban simulations, predictive modelling and city benchmarking, as is underway at CUSP, represents a new chapter in the development of urban informatics,

helping to advance the contributions of computational techniques to urban planning and governance (Bettencourt, 2013). The field is likely to attract increasing talent, enthusiasm, curiosity, and investment in the coming years. However, just as it seeks to extend the possibilities of urban informatics into the domain of urban policy, it too has provoked criticism. Townsend (2014) has written:

> At CUSP, the collection of data is decidedly big, markedly invasive, and intended primarily for researchers and their partners in government to make plans and make policy behind closed doors. It's a moon shot – with huge potential payoff, but tremendous risks and unintended consequences.

Others are likewise concerned about the widespread 'synoptic' surveillance of everyday life. Mattern has accused the new tide of urban data science of falling victim to 'methodolatry', drawing from Janesick who defines this as 'a preoccupation with selecting and defending methods to the exclusion of the actual substance of the story being told' (in Mattern, 2013: para 25). The idolisation of method means, for entities like CUSP, 'the adoration of measurement's image or representation: the knolled toolbox, the hacked perceptual machines, the scientific flowchart, the seductive data visualization' (Mattern, 2013: para 25). More recently, Mattern (2016) has linked the ambitions of CUSP with 1950s behaviourism, the too-easy linking of causality and behavioural patterns. She quotes Hannah Arendt, who cautioned that behaviourism becomes problematic when the very instruments used to measure behaviour become 'constitutive of automation and sterile passivity' (2016: para 29). These concerns reflect a growing ambivalence toward the uses of urban data more generally (extending well beyond the terrain of CUSP's own remit), where the greatest dangers lie in the widespread instrumentalisation of cities 'for data and profit' by Google-backed entities such as Sidewalk Labs. Instead of a future of smartphone-enabled citizens capable of 'reinventing cities from the bottom up', there is a growing awareness that our urban spaces may in fact be transformed into vertically-integrated stacks that allow a single, *data-copious* company to manage everything from traffic management systems, self-driving cars and navigational systems such as Google Maps. In this proximate future, some fear the asymmetries of data access between public and private entities risks destroying 'the very future of democracy' (Poole, 2014).

At this juncture, urban informatics might draw from its origins in seeking to 'ground truth' the urban possibilities of mobile-equipped citizens by extending its field of research practice beyond the device's end-user. Extending from the original interest in how apps might be used to facilitate new modes of urban interaction, more research needs to address the relationships and *contexts of use* that govern data custodians and their 'platform ecosystems'. What are the wider conditions of participation and access that govern public good outcomes of urban data? How do conditions of 'platform urbanism' (Barns, 2015), whereby platform-based business models ensure the generation of urban data largely takes place within proprietary data ecosystems, evolve to support wider social and civic goals beyond those of their business owners? Might we now ask whether the urban spaces of technology-enabled citizenship today orient us towards risks associated with vertical integration, as much, if not more so than heralding the disruptive possibilities of a participatory public sphere?

Cities will always exceed the possibilities of representation. As Sandercock (2001: 1) reminds us, cities are always 'neither organisms nor machines. They are flesh and stone intertwined. They are 'built thought': complex collections of ideas, practices, infrastructures and technologies. Against a backdrop of pervasive computing, big data, urban labs and smartphone-enabled app-tivism, urban informatics continues to evolve as a field of urban practice and knowledge-making, now confident of its ability to advance solutions

to city-scale challenges and 'age old problems'. The recent 'turn' by key proponents of urban informatics against the more corporate agenda of the smart city has also underscored the dangers of relying on digital platforms *per se* as a basis for participatory urbanism. More work, then, is now needed to support critical, longer-term engagement with the co-constitution of cities and informational spaces as complex processes, as much governed by global business strategy as lab-based technology innovation and disruptive local interventions. In any case, to refer to John Rajchman (in Massey, 2005: 159), it is always heartening to remember that a city is not only an object of data flow, or spatial syntax, or complex modelling, though it is, increasingly, all of these things; cities will always undo and exceed definitions, offering new problems for thinking and thinkers, images and image-makers, data scientists and digital refuseniks.

Biographical Note

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Notes

[1] The Centre for Urban Science and Progress (CUSP), Cornell NYC Tech and the Columbia University Institute for Data Sciences and Engineering were all supported through the Applied Sciences NYC Initiative launched under former New York Mayor Michael Bloomberg.

[2] CUSP has also been discussed by Anthony Townsend on Medium, at https://medium.com/the-new-urban-science/two-approaches-to-urban-sensing-synoptic-vs-ground-truth-b584a7285ecb

[3] Eric Paulos' 'Urban Computing' conference of 2006 is credited as one of the first events dedicated to 'urban informatics' in its present form.

[4] Differences in use between European and American approaches have been identified: European approaches use computer science and informatics interchangeably, whereas in the US informatics is more narrowly concerned with the management and analysis of data (Rosenbloom, 2013: 16).

[5] See http://urbaninformatics.net

[6] See http://senseable.mit.edu/realtimecopenhagen

[7] See http://senseable.mit.edu/realtimerome

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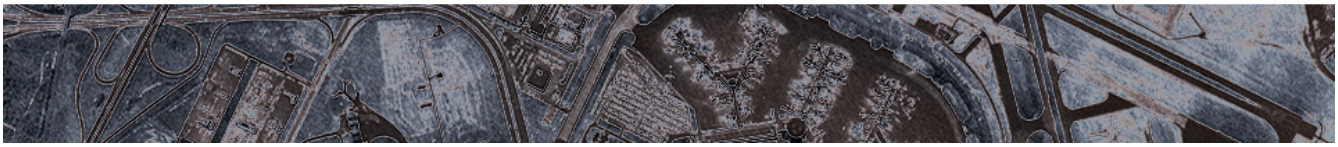

FCJ-215 Demoing unto Death: Smart Cities, Environment, and Preemptive Hope

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Abstract: Today, growing concerns with climate change, energy scarcity, security, and economic collapse have turned the focus of urban planners, investors, and governments towards infrastructure as a site of value production and potential salvation from a world consistently defined by catastrophes and crisis. This paper will interrogate the different forms of futurity and life that are currently emerging from this complex contemporary relationship between technology and design by engaging with two contemporary case studies of greenfield: 'smart' and 'green' developments in South Korea and Masdar in Abu Dhabi. In doing so, the paper will ask how these contemporary practices in ubiquitous computing and green technology are shaping large scale infrastructures and our imaginaries of the future of urban life.

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> Computing is not about computers any more. It is about living.
>
> (Nicholas Negroponte, 1995: 6)

Today, growing concerns with climate change, energy scarcity, security, and economic collapse have turned the focus of urban planners, investors, and governments towards infrastructure as a site of value production and potential salvation from a world consistently defined by catastrophes and crisis. From discussions about 'disaster capitalism' to the embrace of a world after humans, the idea that some environmental, economic, or security catastrophe has arrived, or will arrive, is almost unquestioned. In response, there has emerged a new paradigm of high technology infrastructure development obsessed with 'smart', 'ubiquitous', or 'resilient' infrastructures. Such smartness and resilience must be understood as quite specific as it directly refers to computationally and digitally-managed systems – from electrical grids to building management systems – that can learn, and in theory adapt, through analysing data about themselves. Whether threatened by terrorism, sub-prime mortgages, energy shortages, or hurricanes, the

response is surprisingly similar.

The concept of such responsive or smart environments is often dated to the 1970s, and attributed to Nicholas Negroponte's efforts with the Architecture Machine Group (later to become the Media Lab at MIT), where he supposedly coined the term (Negroponte, 1970; 1975). Negroponte proposed that designers would be able to make architecture better serve populations and address the context of urban degradation and racial segregation in the United States and in the Global South by integrating computation into built environments. Relying on technology, the Architecture Machine Group envisioned buildings and urban designs that could monitor fluctuations in their environment, alter their forms in response to possible changes, and redesign themselves if need be.

Emerging at the same time as a global energy crisis, rising environmental consciousness, and an increase in both urban violence and terrorism, the idea and design of the responsive environment, therefore, has long been married to geo-political crisis (Halpern, 2014b). Sponsored by defense research funding and corporate investment, the Architecture Machine Group was directly invested in producing technologies and urban design solutions in answer to everything from post-colonial conflict, to American race warfare, to transforming corporate research and development. It is perhaps fitting then, that it is Negroponte's famous adage summating the high-technology start-up mentality of the 1980s and 1990s – 'demo or die' – that also most adequately describes this mode of futurity and optimism being espoused in the name of impending disaster in our present.

Our argument is that what differentiates these contemporary smart infrastructures from earlier approaches is not the question of technology, but rather the particular form of spatial and temporal containment and speculation engendered by the logic of prototyping, versioning, and demoing. The development of smart cities follows a logic of demoing, constant prototyping, testing and updating; instead of a finished product, infinitely replicable but always preliminary versions are installed in cities around the globe. At the same time, the idea of the smart city is inextricably linked to notions of catastrophe, where the logic of the demo or test-bed becomes a means for responding to impending environmental, security, and financial destruction by constantly deferring this future from ever arriving. The demo is a form of temporal management that through its very practices and discourses evacuates any historical and contextual specificity of the catastrophe. It is precisely the fact that threat is never fully represented or specified, and that all threats are dealt with in the *same* manner, that is the defining element of the demo as a form of logic and practice. While every event is different, for example the 2008 sub-prime mortgage collapse in the United States and the Tohuku earthquake of 2011 have distinctions, within the demo-logic that substantiates the production of smart and resilient cities, there is rarely any delineation within discourses of smart systems.

This joint logic of both repetitive incompletion and even failure joined with the preemptive anticipation of negative events is central to legitimating the on-going penetration of computation into the environment. It is precisely this evacuation of differences, temporalities, and societal structures, that most concerns us in confronting the incredible rise of ubiquitous computing and hi-technology infrastructures as solutions to the political, social, environmental and historical problems confronting urban design and planning.

In this essay we will explore this phenomenon – what we will label 'preemptive hope' – that ties together the logic of the demo or test-bed, speculation on disaster, sentiments of hope and optimism, and the production of high technology infrastructures. Preemptive hope necessitates the production of new metrics

that measure the environmental performances of these complexes, giving their residents an opportunity for self-reflection and contemplation, and communicating an optimistic sense of potential at a time of future environmental destruction. To map and analyse how preemptive hope works, we will do a quick fly through of two major developments – Songdo in South Korea and Masdar City in Abu Dhabi – which are among the most visible and massive of the smart and eco- city projects started over the last decade, and continue to comprise noteworthy points in debates on urban design.

Inhabiting the Future

Figure 1. Songdo, September 1, 2013

Figure 2. Songdo Marketing Pamphlet 2012

Figure 3. Masdar March 2014

To move from the abstract to the substantive: one hour's drive southwest from Seoul, the new city of Songdo [1] is being built from scratch on land reclaimed from the ocean (see Figure 1 and 2). It is a masterpiece of engineering, literally emerging from a previously non-existent territory. Beneath this newly grafted land, lies a massive infrastructure of conduits containing fiber optic cables. They are largely empty spaces waiting, in theory, to provide some of the highest bandwidth on earth. To the eye of a New Yorker this is a strange landscape of inhuman proportions. Nowhere in the United States are there construction sites even approximating this size. Songdo is thus both awe inspiring and beautiful (Figure 1), and horridly banal. The sheer size, and scale, all grafted from the Yellow Sea, is literally an engineering project of geological scope. The project thus conveys ideas of infinitude in both monetary and technical terms. Its purpose is to sell size, growth, and undefined expansion in the supposed name of some ill-defined notion of 'greenness' and economic development (Figure 2).

Part of the Incheon Free Economic Zone (IFEZ), Songdo is one of three planned developments to be rolled out as the latest testing grounds for the future of human habitation (Zones, 2012). The master plan of the zone envisioned the unification of three functions: the first, high technology research and development and a city expected to house approximately 300,000 people, to which Songdo is dedicated; the second, a central hub for logistics which includes the massive Incheon Airport and port facility; and the third, a planned development, Cheongna (whose current fate post-2008 is unclear) that was to service finance and leisure services. Together – intelligence, logistics, and finance – they comprise a package that is, in the fantasies of its developers, replicable globally. The zone is being developed through a variety of public private partnerships. While the big players constantly change, currently they comprise of Cisco, a California based network infrastructure provider now interested in entering tele-presence and management consulting, and Posco a South Korean chaebol. In the course of the project Gale International (a Boston based Global real-

estate development corporation), and Kohn Pederson Fox Associates (a New York based global architecture and engineering group), have also been involved in building and designing the urban space, and continue to be major stake holders. Although it should be noted that Incheon City and IFEZ took much of the responsibility through a debt restructuring deal in 2013, and are also now the prime owners and beneficiaries of any profits to be made from Songdo.

Much of the financing to date, approximately $40 billion in Songdo alone (Lobo, 2014), was conducted through Morgan Stanley Real Estate and is heavily leveraged (Wikipedia, 2015; Landon Thomasm, 2013). All these groups are global players in both development and technology, and Cisco has teamed up with Posco and the IFEZ authorities to create management consulting and planning services in the interest of assisting other governments and locales with building similar developments – mainly in Ecuador and Malaysia. China, of course, is another major target of Korean management consulting interest. Cisco is also a major global player in the frantic race to dominate the smart infrastructure and city market currently presumed to reach the size of $1,134.84 billion by 2019 (current estimates put the number at $ 411.31 billion), through its 'smart+connected' communities program (Markets and Markets, 2015).

What makes this city so smart is that it is (or planned to be) embedded with sensors that transfer data about atmosphere, trash, electricity, and traffic flow into networked computer systems that can algorithmically (in theory) figure out the most efficient way to respond to changes in behaviors of either the population or the environment. This agent-oriented smartness, not one of consciousness but little actions collectively networked, is viewed as capable of handling and managing a series of future events from the very mundane – direct marketing to smart phones – to the catastrophic – damaged energy grids, crowd sourcing for disaster relief in the case of massive meteorological, geological, or terrorist events (particularly as related to North Korea), and large transportation accidents (Schelemetic, 2011).

Songdo, like any major technical product today, is not an object, it is a process. It is a beta version for urban life. The city is envisioned as a platform deploying this smartness in the interests of perfectly merging corporate demands and consumer lifestyles in a 'safe' and 'optimized' environment. [2] On first inspection, the city does appear to deliver these services. Songdo serves as a high-end suburb to Seoul, mostly for white-collar workers, although there are increasing numbers working within the city. The development is concentrated around a very long and large multi-block open-air shopping mall / street, which serves both entertainment and shopping demands. It has extensive industrial research and office parks including the headquarters of Posco and the UN Economic and Social Commission for East Asia and Pacific, the Global Climate Fund, the central research facilities for firms such as Samsung for biological research, and IBM and KYOBO house electronic book storage and cloud facilities on the site. Finally, it hosts a large university complex, the Songdo Global University Complex, that is home to both local and international schools such as SUNY, University of Utah, University of Ghent, and University of St. Petersburg. The city thus integrates in its plan hi-technology facilities for corporate administration, research and drug production, higher education and access to potential labour, and consumption. Foreign corporations receive tax breaks, but all corporations receive substantial benefits from the enormous investments that have been made (over $30 billion to date) by IFEZ and Incheon City to construct high bandwidth fiber optic infrastructure, smart electrical grids, public transport (including direct subway links to Seoul), and an advanced underground trash processing facility that generates energy as well. The city then, is a demo for urbanism of the future; a prototype for the world. As its initial developer, Stanley Gale, is quoted as saying, 'We want to crack the code of urbanism, then replicate it. We want to build at least twenty Songdos ourselves: the G20 – Gale 20.'

(Arlidge, 2010).

Incheon, in fact, is a leader in creating this new form of codeable territory and life. It was one of the first post-World War II free trade zones started by the Americans to encourage capitalist development in South Korea after the Korean War. Incheon emerged in its contemporary reincarnation as part of former President Lee Myung-bak's efforts to promote green and low-carbon growth, and sponsorship of high technology infrastructure and research as a solution to South Korea's economic woes and security situation in the aftermath of the 1996 currency crisis. In 2003, Incheon was officially legally reassigned as a 'free trade zone' with the accompanying deregulation, tax exemptions for foreign capital and companies, and tax and infrastructure subsidies from the local and federal governments. Where once invasion occurred in the name of containment now airports, automated port facilities, high-tech office parks, and university satellites rise in the name of global integration — or more appropriately global replication (Schelemetic, 2011).

Songdo cannot therefore be treated in isolation. These spatial products are part of what Keller Easterling has labeled 'extra-statecraft': new zones that govern human activity. Such zonal logics do not denote the demise of the state, but rather the production of new forms of territory whose very ideal is an exception to national and often international laws. Free trade zones are thus a growing phenomenon, stretching from Pudong District in Shanghai to the Cayman Islands, and even as far as the business districts and port facilities of New York State that serve as conduits for the smooth transfer of capital, labor, and technology globally. A new networked infrastructure that is linked through the algorithms of GIS and GPS systems and computerised supply chain management systems, and the standardisation of container and shipping architecture, and regulatory legal exceptions, are but a few of the many protocols that produce these spaces (Easterling, 2012).

What makes the smart zones unique, however, in a world of zonal territories, is that they predicate themselves on a dual imaginary of dis-utopia managed through self-organising and constantly self-modulating and updating systems. South Korean developers that Halpern spoke with on site repeated a discourse about the nation as resource poor (particularly in energy), population heavy (although population growth is among the lowest in the world), and surrounded by hostile countries including North Korea, China, and Japan. To these many threats, engineers, but also artists and architects, uniformly responded that it was only Korea's remarkable engineering capacities that had saved it from demise. In fact, South Koreans regularly identified with Halpern's Israeli origins, viewing both nations as closely related in struggling with security concerns, and also in their engineering and entrepreneurial spirit. [3] Such reasoning is not solely the province of South Koreans. It is one of the implicit and automatic assumptions legitimating ubiquitous or smart systems: that increasing computation and data flow in the environment (irrespective of how much energy servers use) will somehow overcome the problems and limits of human decision making and control. The new metrics developed on smart cities become the forms of deferring these threats, enable what we call 'preemptive hope', and trigger a future of economic growth and technological complexity (Figure 2).

While the imaginaries of the future are steeped in threats, what is surprising is that these disasters are presumed to never arrive. When Halpern interviewed engineers at Cisco and government officials from IFEZ, in July 2012 and September 2013, repeatedly the language of Songdo as an 'experiment', a 'test' – in short, a demo – continually reasserted itself (Halpern, LeCavalier and Calvillo, 2013). In fact, few places on

earth share so close an intimacy and so great a love for the demoing ethos and techno-fetishisation of MIT as South Korea; particularly as related to ubiquitous computing projects. The main leaders of the government commissions to build smart cities were all trained at MIT, as were many in the Cisco team. MIT was originally supposed to be a partner in Songdo, and then withdrew for arguably unspecified ideological or conceptual reasons, but most likely, according to other sources, fiscal reasons. MIT's Senseable City Lab was, however, a partner and collaborator on other major projects, primarily the Digital Media City development near Seoul, a somewhat smaller and more targeted development specifically constructed to encourage entrepreneurship in the media production industries. [4]

South Korea has even made it a business and matter of national identity to be the land of the consumer product test-bed. Korea markets itself globally as a test zone, opinion leader and early adopter population; highly urbanised and concentrated, ready to more rapidly consume new technology, offer discriminating feedback, and act generically. By extension, the nation, and particularly the youth zones of Seoul, are regularly billed as the most desirable location to test new products before entering more mature North American, European, and other Asian markets (Kwon, 2010; Lee, 2010).

Songdo, therefore, must be understood not as a city but, as Halpern and her colleagues have written, as a test-bed. It is a platform for testing these parametrically designed and generated cities; and it is part of a global demo ethos that brings us endless versions, updates, and trials – comprised of constant feedback loops between market research, personalisation, and product development. Songdo might fail, but this is only a temporary problem, that will encourage the next version, a better smart city in Rio or New York or Shenzhen, another prototype (Halpern, LeCavalier and Calvillo, 2013). Just as car accidents are regularly re-performed on auto-manufacturer test-beds, so in the case of these massive infrastructures any failure can be contained and managed. Such failures are even the platforms that allow developers to prepare the next version; that enable engineers and planners to unearth that 'code', recalling Stanley Gale, of urbanism facilitating the rapid construction of new cities globally.

In fact, Songdo's occupancy rates are low and its financial future unclear. The entire complex, despite being widely touted in financial news as super-planned and green, is actually beneath sea level and vulnerable to global warming. Thus one must read all this optimism, not to mention the continuous South Korean government's support, the spinning off of management consulting groups to conduct similar such 'tests' globally, and the ongoing preparedness of major investment banks to leverage such developments (Cisco and IFEZ are currently consulting on developments in Ecuador) as articulating a perspective where the world, and life, is just always a test without an end. The function of these territories is to serve as bounded studios within which to integrate finance, computation and digital media with discourses of sustainability, resilience, and survival. Like a modernist piece of montage, these seemingly dialectical oppositions become a single media product, combined into a package that is currently colonising our ability to imagine the future of human life.

'Energetic' Demos

As part of this emerging practice of survival through technology, design, and smartness, the United Arab Emirates also started the construction of a zero-carbon city, titled Masdar City (Figure 3).

The project began in 2006, when the Abu Dhabi government publicised its intentions to invest in renewable

energy and clean technology infrastructures in the form of a multi-faceted state-owned company called Masdar. By investing in renewable energy and clean technology, the Abu Dhabi government hoped to remain a significant player in the energy industry well after its oil reserves run dry (Günel, forthcoming). In the following years, Masdar (meaning 'source' in Arabic) became widely known for Masdar City, a futuristic smart eco-city that was designed by the London-based architecture office Foster + Partners to rely entirely on renewable energies. Masdar City would house 50,000 residents and 40,000 commuters on a 600-hectare area, and cost $22 billion. 'To look at computer-generated images of it, you might think it was a fantasy from a sci-fi comic. The sort I read as a boy', Norman Foster of Foster+ Partners said in 2011, 'But Masdar City, a university city and environmental technology park outside Abu Dhabi, is already being built' (Foster, 2011).

While the eco-city was central to Masdar's vision, Masdar also invested in renewable energy via its other operations – Masdar Power, Masdar Carbon and Masdar Capital. Masdar Institute, the energy-focused research center that was set up and supervised by the Technology and Development Program (TDP) at MIT was founded in a campus amidst the fledgling eco-city.

In a global context afflicted with climate change and energy deficiency, the proposed Masdar City serves to produce a new mode of preemptive hope that would be universally applicable to any location. Like all test-beds in engineering, the function of the prototype is to test extreme conditions; the absolute limits of imaginable situations that a technology must undergo and still remain operable. The producers of Masdar, therefore, imagined the future in the dialectical extremes of both heaven and hell. Conceptions of the approaching end of the world were complemented with imaginaries of a utopian future, driven by a coming together of critical regionalist architecture and high technology. The designers suggested that they borrowed from old Arab cities in thinking about Masdar City, and pointed to Shibam of Yemen as a prominent example. At the same time, the city was going to be smart, or in the words of the architecture critic Rowan Moore (2010), it would have 'a hidden brain', which 'knows when you enter your building, so that your flat can be cooled before you arrive, while in public places flat screens broadcast uplifting news on the environmental performance of the complex'. Framed as a utopia or science fiction project, which might be achieved, Masdar City needed the backdrop of a world struck by climate change and energy deficiency. The marketing and communications campaigns put together by Masdar aimed at proving that the opposite was also true – that the world needed Masdar City.

'We are creating a city where residents and commuters will live the highest quality of life with the lowest environmental footprint', announced Sultan Al Jaber, then the CEO of the renewable energy and clean technology company Masdar, during the groundbreaking ceremony in 2006. 'Masdar City', he continued, 'will become the world's hub for future energy. By taking sustainable development and living to a new level, it will lead the world in understanding how all future cities should be built' (Masdar Institute, 2008). Masdar City was conceptualised as a role model for the world, whose proponents argued: one day all cities will be built like this. Masdar City would demonstrate how a combination of high technology and better architecture could provide luxuries with a zero carbon footprint.

Some people associated with Masdar called the city a 'spaceship in the desert' stressing the self-contained nature of the project (see Günel, 2016). In this understanding, Masdar City was an innovative technological model, proposing a means of survival based on rational scientific calculation and management. The experimental hub would technologically maintain the livelihoods of its residents, even if the earth could not

provide the right living conditions for the frontier people on the ship. As Peder Anker shows in his history of ecological architecture, this is by no means a new trend in design. Since the 1960s, cybernetically informed imagined or real environments from space have inspired the making of ecologically sensitive architecture, underscoring that adopting space technologies constitutes the singular means for being in harmony with the ecosystem. According to this perspective, space provided an alternative environment of peace and rationality, standing in opposition to the destructive and irrational crises of the earth (Anker, 2010). The spaceship therefore served as a finite, computationally and technically sophisticated and insular habitat for a group of beings facing an outside world of crises. In the words of Peter Sloterdijk, the spaceship would offer an 'exclusivity dressed up in claims to universalism' (Sloterdijk, 2014: 263). Likewise, Masdar City set a contrast to the current fossil fuel driven economies of the world and to the future world of climate catastrophe. The imagined eco-city not only relied on a future oriented temporality, but also reproduced a particular spatiality with firm boundaries.

These are spaceships with peculiar properties. While it is assumed that failure of any system in space leads to death, here death is forestalled by rebranding or reframing. Currently, for example, one hundred or so Masdar Institute students reside at Masdar City, occupying the dorm rooms of the Masdar Institute campus. Around three hundred professionals who work with Masdar (and recently with Siemens) commute there from Abu Dhabi or Dubai. In addition, there are many male low-wage immigrant workers on site, who are bussed back to various labour camps at the end of every workday. And yet construction efforts have stalled since the 2008 economic crisis. The Foster + Partners master plan has been cancelled. These days, Masdar City is underlining its identity as a special and smart economic zone, promoting its capacities as 'the city of possibilities' [5] with perpetual potential, and inviting technology companies to come and build inside the 600 hectare area, which neighbours the Abu Dhabi airport and the Formula 1 tracks.

Like Songdo, Masdar operates on a model of temporal and spatial bounding into the logic of demonstration, where failures are turned into experiments and justifications (in a seeming irony) for ever more integration of technology, particularly computer and digital technologies, into the environment; and ever more speculation, algorithmically managed, to derive value from the possible, never realised futures that these spaces might produce. In these cities, the site of performance and demonstration associated with democracy and the demos, terms first emerging with the idea of the polis or city, have now become a literal demo as in prototype. The inhabitants of Masdar City are test subjects, responding to this prototype in real time (Günel, 2014). The performance of the infrastructure has become a logic in itself that bounds time and space, in order to manage futurity without needing to know the endpoint, and always legitimising another version, another brand, another derivative, another technical system. In fact, it is the seeming separation between the computational and prototype infrastructure, and the lived world that is precisely the justification for ever more testing, demoing, and development of technology.

Technological Futures

A fantasy of the future managed, or destroyed, by technology is nothing new, of course. Since the nineteenth century, machines have been envisioned as leading to both the emancipation and destruction of humanity. In the past six decades, technologically realisable species suicide has been a historically unique and specific site of fascination, made possible by way of nuclear weaponry. What is interesting, however, is the way that today’s demos and test-beds differ in their logic from the game theories and simulations of nuclear war.

One of the most powerful ways to think this difference is through distinguishing between risk and uncertainty. If the Cold War was about nuclear testing and simulation as a means to avoid the unthinkable but nonetheless predictable – nuclear war – the formula has now changed. [6] This distinction is best summated in the separation between risk and uncertainty first laid out in the 1920s by the economist Frank Knight. According to Knight, uncertainty, unlike risk, has no clearly defined endpoints or values (Knight, 1921). It offers no clear-cut terminal events. In this case, the test no longer serves as a simulation of life. Rather, the test-bed makes human life itself an experiment for technological futures. This uncertainty embeds itself in our technologies – both of architecture and finance. Thus in financial markets we continually swap, derive, and leverage never fully accounted for risks in the hope that circulation will defer any need to actually represent risk, and in infrastructure, engineering, and computing, we do the same.

As future risk transforms into uncertainty, smartness becomes the language by which to imagine our future. Instead of looking for utopian answers to our questions regarding the future, we focus on quantitative and algorithmic methods. Smartness, the dominant method for engaging with possible urban collapse, then becomes our new catch phrase for an emerging form of technical rationality whose major goal is management of an uncertain future through a constant deferral of future results or evaluation through a continuous mode of self-referential data collection without endpoint; what Shannon Mattern has labelled a methodolatry, a constant obsession with methods and measurement to constantly assess prototypes that are never completed; an assessment of results without endpoint (Mattern, 2013).

There is a profound difference between knowing the future, as under the conditions of nuclear war, and acting under conditions of climatic, energetic and economic uncertainty to which smart urban planning responds. At Songdo, which serves as a potent example of the management of uncertainty, Cisco executives and government employees repeat this discourse ad infinitum – bandwidth is valuable even if its function, and monetisation, has not yet been determined. So huge conduits (they are some three feet wide in Songdo compared to the less then a foot wide in NYC for example) for fiber optic cables are built, the environment is embedded with sensors and responsive systems – from garbage to electrical grids – all the while the space stands largely, still, empty. More interestingly, despite Songdo's lack of accomplishment or profitability, the idea of this smart city linking finance, high tech research, green infrastructure, and the perfectly customised consumer lifestyle has already propagated through the financial news and the services of firms such as SAP, Siemens, Cisco, IBM, Morgan Stanley, and Arup and to many different locations from Rio's Operation's Centers to the Gherkin in London. The outcome, or even the efficiency, environmentally or energetically, of these developments and buildings is impossible to assess with accuracy, and no one even tries. This is a future no longer described, but simply acted upon with zeal and speculative optimism.

Figure 4. Incheon Bridge with Costs, September 1, 2013

Figure 5. Songdo Control Room, September 2, 2013

Figure 6. Masdar Master Plan Foster and Partners March 2007
(http://www.fosterandpartners.com/media/Projects/1515/img0.jpg)

Disaster Aesthetics

The most striking feature, therefore, about all this speculation and demoing on and of the end, is its absolute positivity and hopefulness. Hope is an affective state, an emotion that induces new types of methods and techniques such as big data analytics or parametric design, and allows designers and policy makers to act upon the uncertain future with ease. As such, hope is also an aesthetic category; a particular organisation of sense that mobilises, in the Rancierian understanding, affect toward action. It therefore behooves us to understand not only the technical and rhetorical infrastructure of this demoing until death, but its aesthetic sensibilities and tactics. The demo or test-bed is a practice of the senses, a mode of aesthetic strategies and performances born of modern architecture and computer-aided design. Masdar City and Songdo are the exemplars of this new type of emotionally demarcated territory, both literally architected into space and figuratively existing in our imaginations and desires.

Designed by Norman Foster's office in London, Masdar City (Figure 6), for example, is beautifully rendered in advanced building materials. While some of the buildings mirror the desert surroundings in their color and draw on critical regionalist architecture, others replicate the gleaming light grey of a spaceship and highlight the technologically complex nature of this new center of renewable energy. The residential units boast terracotta walls of reinforced concrete and rely on contemporary interpretations of mashrabiyas to block sunlight and foster privacy. The laboratory buildings are insulated from the heat by façades filled with inflatable cushions, which remain cool to the touch. In their marketing and communications, these buildings promise to offer a temperate climate, while contributing to an economy of knowledge production; all theoretically with zero carbon footprint. The arid desert that in fact gives life to Abu Dhabi through its multiple resources, most importantly oil, becomes marginalised as an other space that cannot be dwelled

except in this manner. Its managing executives, experts who hail from around the world, conceptualise this new territory as an opportunity for capital investment and technological experimentation in the backdrop of a world struck by climate change and energy deficiency. Masdar City is promoted as a utopian living arrangement that acknowledges and resolves the current energy crises of the world, while mitigating climate change. It is a Live-Work-Play space, which will grow one neighborhood at a time. It refuses a vision of a world in decay but rather envisions a world that indulges in its dissolution.

Inside, Masdar City employs alternative modes of transport. The personal rapid transit (PRT) pods, the planned mode of transportation within Masdar City, were first exhibited on the opening day of the World Future Energy Summit in Abu Dhabi in January 2009, giving visitors a sense of the eco-city's futuristic ambitions. Designed by Zagato, an Italian engineering company famous for racing cars, and manufactured in the Netherlands by 2getthere, the pods were perceived to be the most innovative element of Masdar City. One blogger who reviewed the exhibit suggested:

> The comfort and safety of the pods shows us a rather favorable vision of the future. Ride on cushioned seats, holding hands or facing each other. Have a conversation, catch up on the morning news. The car will stop to let you off at your chosen destination. Chauffeurs for everyone, and Green at that? That's our future? Not bad. Not bad at all! (alternate-power.org, 2009)

The pod cars confirmed that our future would be one of technological complexity, just like what we imagine when we watch science fiction movies. They evidence that our imaginaries of the future would remain untouched by problems of energy scarcity, and offer a comforting and enjoyable narrative in the face of environmental conditions that are deeply unsettling.

Masdar City's neighbors also promote hope and fun. The Formula 1 tracks have been hosting the Grand Prix since 2009 in Yas Island. The Al Ghazal Golf Course is older, serving golfers since 1997. All of these zones assist the drive for economic diversification in Abu Dhabi while at the same time putting the Emirate's name on the map, promoting its brand image for diverse target markets. In their segregation from Masdar City, these carbon intensive sites stage different pathways towards which Abu Dhabi's economy can be steered. They demonstrate that Masdar City is not necessarily symptomatic of a greening effort across the Emirate – it is only one of the experiments towards the production of a future that depends less on oil revenues. Although they can easily be perceived as dissipated or unrelated spaces with no common social basis, the Formula 1 track, the golf course and the eco-city all comprise segments of the challenge to generate non-oil based revenues for the Emirate, united under the drive for possible future profits. The segregated units with seemingly contradictory agendas and drastically different relationships to climate change and energy scarcity stand together, because they are all experiments for economic diversification, designed to anticipate a future with less oil revenues.

Songdo promotes other pleasures – those of undefined futurity and eternal growth (Figure 4). Songdo is thoroughly uninspired architecturally, but incredible in its display of size and infrastructure (Figure 5). The marketers for the Incheon Free Economic Zone have strategically placed an observation deck on their skyscraper headquarters. From this observation deck, residents and visitors will marvel at the raw size of the construction site, and gaze at the seventh longest cable-stayed bridge in the world leading directly to Incheon Airport. This spectacle of high-end development titillatingly reveals that behind the smooth towers and luxury condos there is another infrastructure – that of Incheon Airport and Port – two of the most high-

tech and largest transport and logistics facilities in East Asia. This suggestion of infinite circulation – of capital and people – all mediated through computing, offers a sentimental and aesthetic answer to uncertain disasters of environment and economy. Songdo, and the Incheon Free Economic Zone, thus serve as a vacillating network awaiting purposes not yet assigned, and preparing for environmental and economic disasters that have not yet been assessed or definitively calculated and whose temporal horizons are eternally deferred.

Within Songdo, planners are careful to regularly point out that the environment is hyper-responsive. The centerpiece of this responsiveness is the quite showy, and seemingly unnecessary, 'smart' pole. This very key element of Songdo, as well as other Korean smart city developments, is a device lauded and circulated as *the* design element for inducing happy (literally labelled that in the marketing) environments. They are very visible in the landscape (Figure 7). In theory, smart poles monitor crime and traffic and issue traffic violations through their sensors and surveillance cameras. They also offer location based and personalised marketing by providing public Internet service and by linking to cell phones passing in the area, and they might, some planners suggest, even play personalised ambient music and sounds to make the environment soothing. They also give light, and in some designs, different colours (again to match with mood). To safeguard the 'happy' population these poles are also linked to disaster services and monitor for accidents and outdoor medical emergencies, along with environmental particles and, in certain designs also sense for radiation and chemical weapons (ostensibly from terrorist events, New York City already has installed such poles as part of its post- 9-11 preparedness program). In South Korea what makes these little happy-inducing disaster monitoring poles seem strange is their deliberate visibility, alongside their almost complete unnecessity — considering the already extant GIS/GPS systems and direct to consumer marketing in every smartphone, existing wi-fi and surveillance camera infrastructure within transport and public spaces, and the prevalence of fitbits and trackers and other sensor systems on and in the bodies and environments of contemporary cities and their denizens. The marketed and widely broadcast and designed visibility of these poles must, therefore, only be understood as another disaster and security aesthetic performing and demoing the ideal of a smart environment that provides security and comfort within its confines (Figure 10).

All this happiness is refracted in the gleaming marketing materials issued for Songdo, Masdar, and a myriad of other similar complexes in locations ranging from Azerbaijan to China. As other architectural critics have also noted, almost every such real-estate development on earth has a similar video usually involving a scalar swoop into the city from space, and a fly through the main architectural spaces, all landing on images of consumer-citizens easily downloading data and services from their smart phones and / or perched in their shiny offices (Allais, 2014; Easterling 2012). The buildings are almost always rendered as though aerodynamic and ergonomic, maximising the flow of people, energy, and information. This effect is created through long tracking shots merged with renderings that lack strong light and shadow thus intimating pure flow without resistance through the city, and between interior and exterior spaces. This seamlessness is amplified, at least in the animated adverts for Songdo and Masdar City, through many scales, from the individual smart high-tech employee in their office on their smart devices, up to satellites that suggest links to global supply chains directly referred to by showing the airport and adjacent shipping facilities as well as recording the time it takes to reach major global centers. Songdo's promotional material is created with the latest standardised computer aided rendering, while at the same time making obvious use of standard objects and forms from already available templates. The whole experience feels low quality. The feeling of obsolence is enhanced by the fact that many features of the city in the Songdo

promo and the Masdar City videos have yet to be built.

In line with the culture of demo, and according to sales reps, this failure only proves how great the next version of the city is. In Songdo, economic disaster has been met with resilience; instead of trademark buildings by big name architects, cheaper condos were built, and universities were found to rent space. Instead of being zero carbon and absolutely green (a goal IFEZ gave up in the name of deregulation and encouraging development) now the United Nation's offices that regulate the environment reside in the more cheaply built office buildings! In Masdar City, the master plan has been cancelled, allowing third parties to come and build inside the declared green special economic zone. Masdar City will no longer be zero carbon, but it will experiment with climate change knowledge, technology and governance, and impose sustainability protocols. To this end, it houses the International Renewable Energy Agency (IRENA) global headquarters, a tenant that moved in to the city in June 2015, as well as Siemens Headquarters, and hopes to attract others, such as Doubletree Hilton. The part of the city which was built according to the Foster + Partners master plan – that is the Masdar Institute campus – remains perched atop a 20 feet basement level.

Figure 7. Pionen Datacenter, Stockholm Sweden (http://i.dailymail.co.uk/i/pix/2010/12/09/article-1337014-0C685E1B000005DC-868_634x419.jpg)

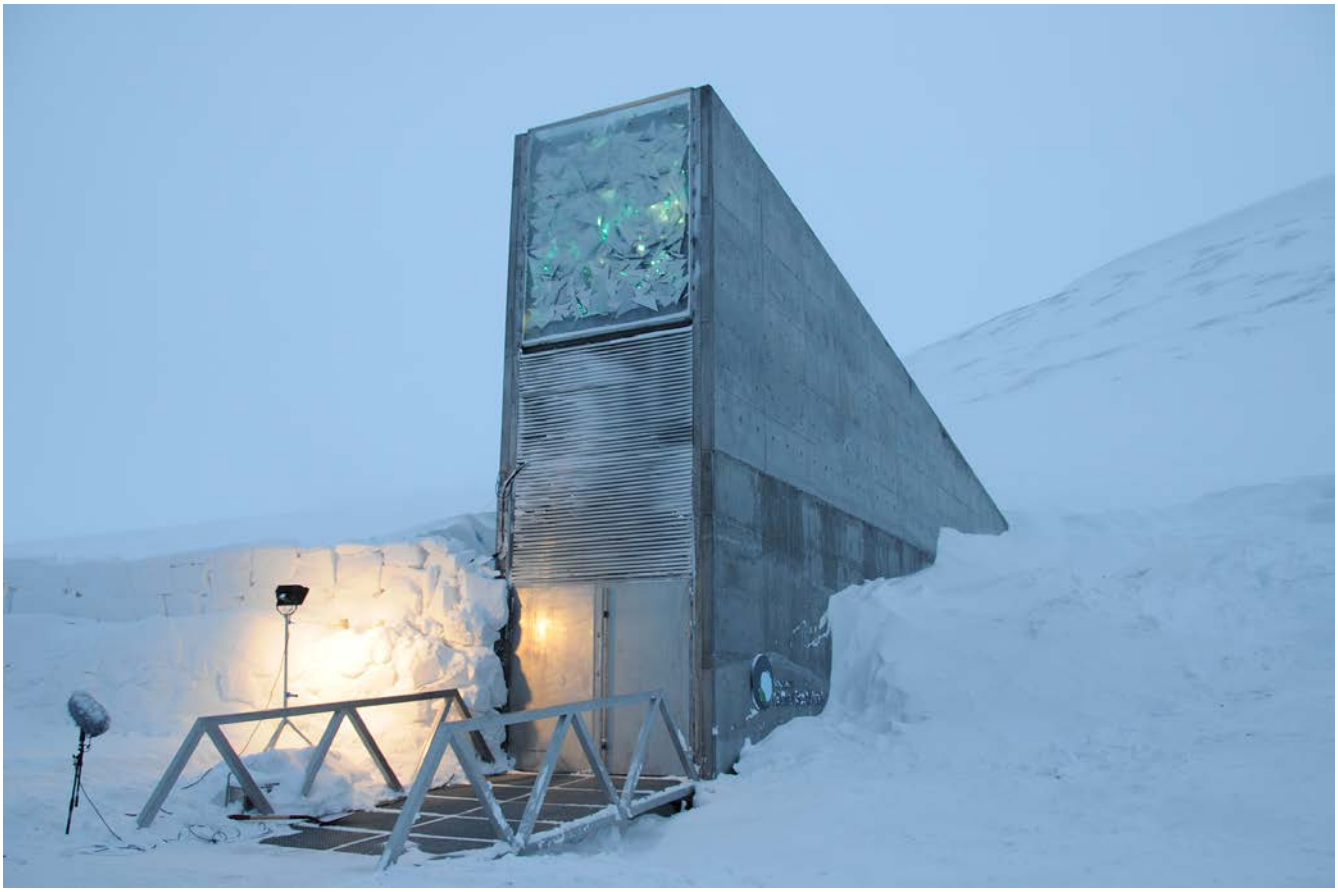

Figure 8. Norway Svalbard Seedbank (http://earthsky.org/earth/seeds-of-time-to-hit-theaters-in-may)

Figure 9. Gardens by the Bay, Singapore (http://www.123rf.com/photo_29814333_gardens-by-the-bay-an-integral-part-of-a-strategy-by-the-singapore-government-to-transform-singapore.html)

The demo in these cities is, therefore, not like that of seedbanks or server farms that are imagined as bunkers against change. Instead, the urban test-bed is a site where futurity collapses into contemporaneity. It is envisioned to be *in* time; syncopated to the moment that there can be no history, only an eternal and repetitive obsolescence. [7] 'Demo or die' is not a threat, it is an invitation to participate in a new practice; perhaps one that will replace the older demos of democracy and realms of appearance, into a neo-liberal call for endless digital entrepreneurship and creativity. These cities appropriate the public realm of appearance, that was once *the demos* and transformed it into the demo, also a realm of appearance, but one with severely limited temporal horizons, group imaginaries, or citizenship benefits. The demo allows us to die, repeatedly, under the safe, secure, and in theory, profitable watch of our networked machines.

Alternative Hope(s)

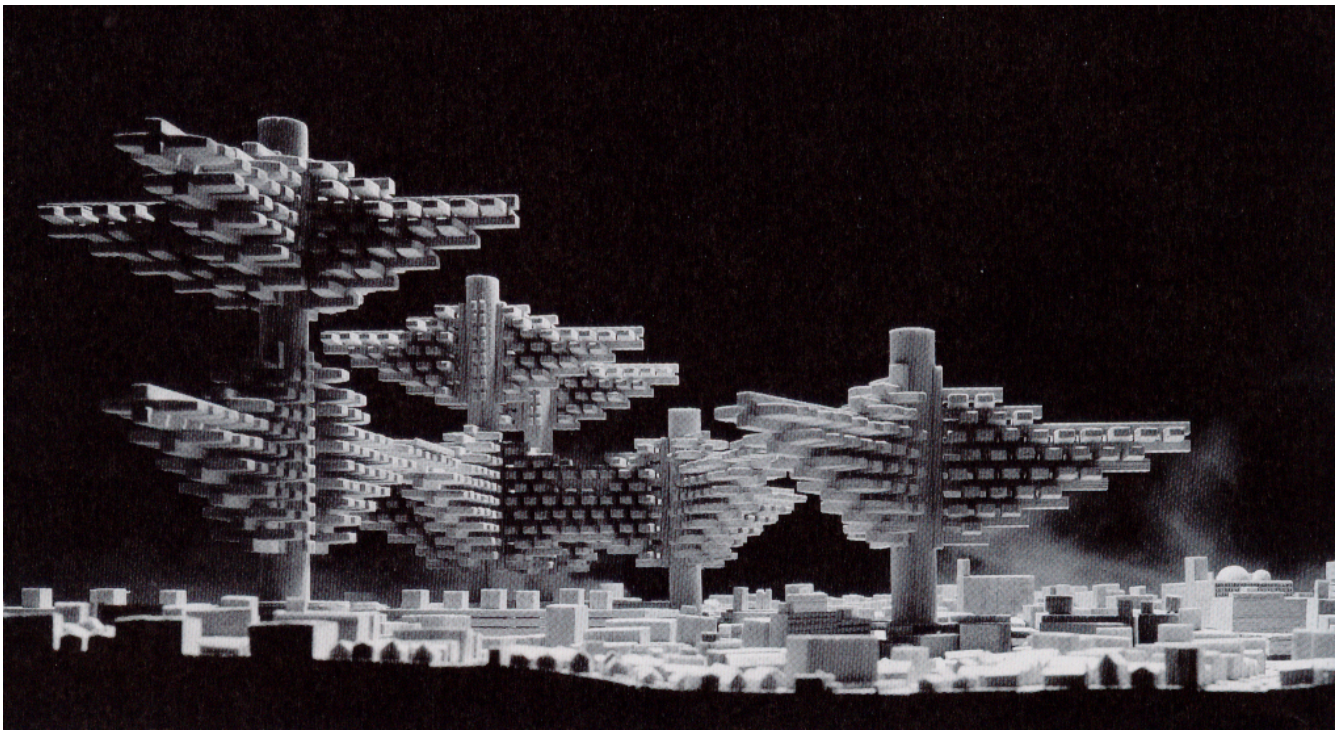

Figure 10. Arata Isozaki, 'Clusters in the Air for Tokyo', (1960-62) (https://workjes.wordpress.com/2008/01/30/clusters-in-the-air/)

Death is not the only option. It behooves us to examine other moments where devastating disasters were responded to, to ask about different possibilities, to develop new vocabularies. To this end, we wish to demonstrate a possible alternative vision of the future of a high technology Asian city. The work of Japanese architect Arata Isozaki is shown above (Figure 10). Isozaki, like so many engineers and designers in today's smart developments, attended MIT for training in the 1950s, leaving the war-destroyed Japan to learn about American architecture. He is famous as an affiliate of the Metabolist movement of architecture.

Metabolism is a different idea for thinking the future. Metabolic processes have complex relationships to death. They are both mechanisms for assimilating the outside into our bodies, and mechanisms for producing growth and change. Metabolism is about decomposition and growth at the same time; it is at the center of life. The Metabolist movement also reflected this idea. Emerging out of a devastated post-World War II Japan, these architects and designers attempted to envision a future for their cities.

As Japan was recovering from American air raids and atomic weapons, it became significant to contemplate

possible relationships with this history of destruction. In the Arato Isozaki project, the future was constituted through hanging buildings with computerised control that would hover over the past, the remains of Tokyo, rather then destroying all memory of the past and its traumas. The mega structure offered a solution that bridged the dreams of developers at that time: to build homogenous constructions; anticipating the Songdos and Masdar Cities of the world, and the nostalgia to return to a pre-war way of life, to Empire, and to the village like structures and small paper homes of Tokyo. Neither smart nor dumb, not making the decision between the end or the past, these structures emphasise and attempt to work through notions of time and change; metabolism as architecture. The mega-structure would insert technology in a floating territory above the old Tokyo, leaving both temporalities to work at their own pace, allowing Tokyo to remain partially un-rebuilt, still scared and mostly destroyed, a constant rent in the fabric of time. These multiple temporalities operate simultaneously, neither returning to the past, nor falling into an eternal present. Neither seeking to forget Japan's own militarism and obsession with technical death, nor attempting to cease the use of technology.

We must attempt to find ways to use our graceful machines and networks in different ways. There is, therefore, still critical work to do — in art and in scholarship — to envision, and to sense, alternative images of the future; to produce images of life that are not the same as those we make in the present. What is now required is to realise that uncertainty is possibility. The pleasures of insecurity need not be solely diverted into spectacles of consumption. We have to open the discussion about what constitutes management and control, and how to add temporal multiplicity, whether it is allowing weeds to grow as a strategy to 'green' cities, or thinking about multiple aesthetics not just spaceships or sleek glass towers. The future of politics therefore demands that we imagine alternative futures and split with the techno-futurist, and modernist, aesthetics borrowed from science fiction or from urban planning, design, and technology. We must move past questions of survival to pose another question; not how *must* we survive the present, but how would we *like* to live in the future?

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Orit Halpern is a Strategic Hire in Interactive Design and Theory and an Associate Professor in the Department of Sociology and Anthropology at Concordia University, Montréal. Her work bridges the histories of science, computing, and cybernetics with design and art practice. Her most recent book

Beautiful Data: A History of Vision and Reason since 1945 (Duke Press, 2015) is a genealogy of interactivity and our contemporary obsessions with 'big' data and data visualisation. She is now working on a large multi-site research project examining futurity, computation, and large-scale infrastructures. You can find out more at www.orithalpern.net.

Notes

[1] The research conducted in Songdo, South Korea, was done in collaboration with two architects / designers – Nerea Cavillo and Jesse LeCavalier, and with the excellent assistance and translation help of Electronic Arts Curator – Dooeun Choi. Orit Halpern is indebted to all of them for the inspiration and education they provided.

[2] Safety is one of the most prevalent discussions repeated by sales reps and government administrators. In Halpern's two visits to Songdo, the first in 2012, and the second in September of 2013, a marked shift had moved to accepting the possible threat of North Korean sabotage or attack of computer and other networks, as well as the possibility of other types of biological or nuclear weapon use. Government officials also emphasised the profitability of the complex, its rising rates of occupancy, and the technical and business aspects of the complex. Interviews conducted September 2, 2013.

[3] Taken from promotional materials and interviews with IFEZ officials, Kyung-Sik Chung (Director of Cultural Affairs) and Jongwon Kim (Director of Marketing and Development for IFEZ Authority), on July 4, 2012. See also: http://en.wikipedia.org/wiki/Incheon_Free_Economic_Zone#Yeongjong_Island;

http://www.fez.go.kr/en/incheon-fez.jsp. Taken also from interviews with many curatorial staff at The Seoul Art Museum, and particularly with Dooeun Choi, September 9-13, 2013, and with the architect Taeseok Ha, of SCALe, on September 12, 2013.

[4] From interviews with Professor Dr. Donyun Kim, Professor of Urban Design at Sung Kyun Kwan University at Samoo Architects and Engineers on July 3, 2012 and September 11, 2013. Dr. Kim was also one of the lead members of the Presidential Committee on Ubiquitous Computing and Infrastructure in 2013-14.

[5] See the Masdar City website for this slogan: http://www.masdar.ae/en/masdar-city/detail/we-are-masdar-city-the-city-of-possibilities

[6] It is important to recognise that there are also alternative histories of temporality and control within computing coming from cybernetics. In the work on organisations and economics from figures such as Herbert Simon, and in the work on neural nets coming from the heritage of Warren McCulloch and Walter Pitts, ideas of fuzzy problems and logic were prevalent, and preemption, not prediction, was a dominant theme. These influences went on to be very important and influential in engineering and financial culture, particularly through the figure of Nicholas Negroponte and through architectural collectives such as Archigram and the Metabolists. For more information, see Halpern (2014a) and Erickson et al. (2013).

[7] The architectural historian Daniel Abramson has suggested that obsolescence as a defining term in urbanism, and as a concept governing urban planning and design began to emerge in the immediate post-

World War II. See http://www.grahamfoundation.org/grantees/5127-obsolescence-an-architectural-history

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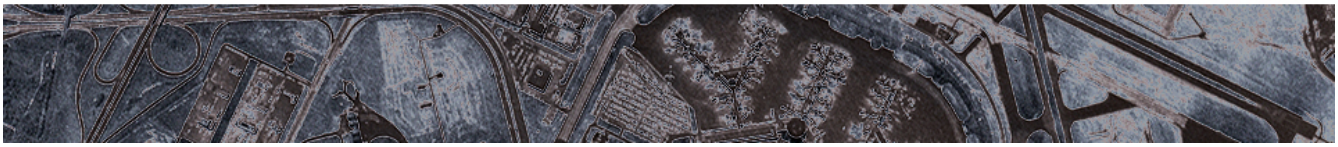

FCJ-216 'Know Your Place': *headmap manifesto* and the Vision of Locative Media

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Abstract: Ben Russell's *headmap manifesto* (1999) is an early and highly influential example of the discourse around commercial location-aware technologies that accompanied their emergence at the turn of the last century. Although numerous theorists acknowledge its influence on the fields of urban computing and locative media art, there have been few close analyses of the text and little consideration of its ongoing relevance in the current era of smartphones, location-based social networks and 'smart city urban planning initiatives. In this paper, I seek to address this shortcoming through a close examination of *headmap* and its influence on the discourse around what became known as 'locative media'. I argue that *headmap* offers a polemical, utopian vision of the world as it might have been, but also highlights the disparity between academic and artistic discourses around location-aware technologies and their current mainstream application.

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> What is the point of all the extraordinary technical inventions the world now has at its disposal if the conditions are lacking to derive any benefit from them, if they contribute nothing to leisure, if imagination is absent?
>
> Constant Nieuwenhuys, 'Another City for Another Life' (2006/1960: 71)

Introduction

When the *headmap manifesto* first appeared in 1999, Google was barely a year old, the U.S. government had not yet removed the GPS signal degradation that prevented its widespread commercial use, and Apple's iPhone was still almost a decade away. Predominantly written by computer engineer Ben Russell, *headmap* (always spelt in lower case, although I capitalise it here when beginning a sentence) envisioned a world not entirely unlike the one we inhabit today, in which location-aware devices have radically transformed everyday life. It foreshadows recent developments from the emergence of location-based

social networks like Foursquare and Yelp to dating and hookup apps such as Grindr and Tinder. In contrast to the strongly commercial, proprietary-driven nature of these applications, however, *headmap* foresaw these practices as emerging from the ground up. The potential for GPS technology to be integrated into every device and object would allow individuals to tag physical places with virtual information, provide site-specific advertising, organise community events and track people and objects. These practices, *headmap* claims, would lead to nothing short of a revolution of everyday life, transforming the way territory, architecture, politics, sex and social interaction are understood and enacted. We are at the precipice, it proclaims, of a 'new world' where 'augmenting and annotating reality will lead to a new conception of space, new ways of looking at land ownership, new kinds of communities and states' (Russell, 1999: 8).

Theorists such as Anne Galloway (2008) and Andrea Zeffiro (2012) acknowledge *headmap*'s conceptual influence on practices from urban computing to the 'locative media' movement. The document is even mentioned in a 2003 *Guardian* feature article, which quotes its author as declaring that 'the real possibilities for location-aware phones are predicated on contribution and sharing rather than centralisation and broadcast' (Russell quoted in McClellan, 2003). But since its publication *headmap* has gradually faded into obscurity, as the practices it saw as innovative and revolutionary at the time – tagging, tracing, and annotating physical locations; sharing one's location and actions with others in real time – have been commercialised and rendered commonplace for anyone who owns a smartphone. Meanwhile, there have been few close, full-length scholarly analyses of the text or, more importantly, any considered assessment of its ongoing relevance in the present era of ubiquitous location-awareness and 'smart city' urban planning models. [1] While it is not infrequently cited in scholarly literature in the field of mobile and locative media studies, with the exception of Zeffiro and Galloway it is seldom mentioned as more than a footnote. This paper seeks to rectify this lack of critical engagement with the text by undertaking a close reading of *headmap* and dissecting its historical importance as well as its ongoing influence on the present uptake and use of location-aware devices. The paper also situates the text in present debates over urban computing and locative media while reflecting on how its call for a grassroots, user-led appropriation of location-aware devices might still hold value today.

I begin by outlining and critiquing the *headmap* document itself and situating it within the broader context of how understandings of the relationship between digital technologies and urban space were evolving at the time of its publication. I then focus on the influence of *headmap*'s vision on the locative media movement, which strongly reflected the utopian – and sometimes dystopian –themes of Russell's text. Lastly I situate *headmap* in the context of current developments, with the advent of smartphones and pervasive GPS technology simultaneously realising Russell's vision of ubiquitous location-aware devices and closing off their radical potential. I argue that *headmap* not only remains an invaluable resource for understanding how location-aware technologies were understood at the time of their emergence, but it also accurately predicted and helped shape their subsequent development. This moment has well and truly passed, however, and the seeming disappearance of all traces of Russell and the 'headmap collective' he represented underlines the disjuncture between the adoption of location-aware technologies by academic and artistic circles and the actual uses of the technologies today.

'Geography Gets Interesting'

[2]

In 1999, Ben Russell published a 34-page document online called the *headmap manifesto*. [3] While the text is usually attributed to Russell, his name is not mentioned in the document and it was possibly written with other unacknowledged contributors.. The text optimistically describes a utopian near-future where location-aware devices have become ubiquitous and universally accessible, integrating themselves into the architecture, objects and public infrastructure of cities, reshaping the everyday lives of their citizens. It mostly celebrates the arrival of GPS tracking and mobile devices with the ability to store location-specific information about their users, proclaiming that they have the potential to revolutionise the way people interact and communicate from the ground up. Russell writes, 'what was once the sole preserve of builders, architects and engineers falls into the hands of everyone: the ability to shape and organise the real world and the [sic] real space' (1999: 2). It is an eccentric text, combining political commentary, poetry and haiku with quoted passages from sources as eclectic as Umberto Eco, Lewis Mumford, members of the Situationist International, a book about indigenous Australians' definition of place and an 'epic poem' about plants and herbcraft. These statements, quotations and musings are scattered throughout the document, roughly grouped under many headings and subheadings that correspond to a broad concept – 'architecture', 'dreams', 'maps', 'nature' and so on. Through the juxtaposition of these text fragments, *headmap* imagines a future transformed by location-aware technology in which the possibility for social, sexual and playful encounters with others are made increasingly commonplace and pervasive through technology. As Zeffiro writes, 'Russell amassed discourses of radical cultures of technology, politics, sexuality and community formations, in conveyance of a utopian future, in which everyday life is cushioned and dynamically energized by location-aware devices' (2012: 254).

The document's introduction contains what comes closest to a manifesto-style call to action. It argues for a shift from an 'inside' to an 'outside' way of being: away from the private space of the home, mind and computer screen to 'a recolonisation of the real world, computers becoming invisible, mobile, networked and location aware, the real world augmented rather than simulated' (Russell, 1999: 5). The remainder of the document describes how different aspects of everyday life will be transformed by the presence of location-aware devices. In this sense, *headmap* is a surprisingly prescient text. In a line that foreshadows the kinds of site-specific artistic projects and social networking applications that have since become commonplace, Russell (1999: 4) writes 'using a network you can publish the coordinates of a place with a note attached. That note can then be "found" by another user who visits the same place.' It also somewhat predicts the rise of apps like Yelp and Urbanspoon (renamed in 2015 as Zomato) that allow users to review places they've visited and share them with friends and other users on the network. Russell (1999: 32) describes 'entering a restaurant [and seeing] a huge burning skull in the middle of the room. Nobody else sees it. The skull was left at this geographical location by one of your peer group indicating that the restaurant is terrible.' Similarly, it anticipates the possibility for companies like Google, Facebook and Foursquare to track and analyse their users' data. Russell foresees individuals walking down the street and seeing one's mobile device light up 'with dots which represent places of interest determined by [the networks of] Starbucks [and] McDonalds' in addition to 'information based on your personal profile and the suggestions and opinions of your peers' (1999: 31). It also hints at the future rise of apps for dating and 'hookups' (one-off sexual encounters) imagining a world where 'sex and even love are easier to find' (1999: 4). And it even predicts the development of location-based gaming, describing 'computer games...that actually get kids out of the house and running around instead of being stuck in front of a computer screen' (1999: 32).

Although it is a fragmented, disordered text, there is a series of arguments and musings to be found as one

progresses through the document. I will offer a brief sketch of these here, although given the document's highly non-linear structure this must be taken at best as merely a paraphrasing of its far denser and more complex, convoluted ideas. First, Russell concentrates on the consequences of location-aware devices for the way we conceive of and regulate land and territory. Drawing on scholarly texts, as well as ethnographic reports and case studies primarily of indigenous Australians, he argues that tribal cultures have historically had a more fluid and nuanced understanding of space and territory than their European colonisers. Objects that are mundane to Western colonialists – trees, shrubs, rocks – had their own individual meanings or names; travel was conceived in terms of 'journeys' rather than following 'roads and paths'; and territorial boundaries were much more dynamic and in constant flux. 'The aboriginal concept of space clashed with Western ideas of law and land ownership', Russell (1999: 11) writes. 'Colonial settlers parcelled land up into neat rectangles enforcing these arbitrary boundaries with force and punishing trespassers.' Russell then reflects on the way contemporary life follows generic, predictable patterns, not unlike the military, in which soldiers are conditioned to follow highly routinised behaviour. We visit the same places each week, follow the same paths from home to work and back again, rarely deviating from the norm. Not only are our predictable, regimented lives reinforced by modern urban planning, marketing agencies and the media, but they also become captured and appropriated by these institutions and corporations, fuelling a highly consumerist urban life: 'human patterns have become commoditised' (1999: 13). [4]

Russell then shifts the discussion to location-aware devices, arguing that they hold the potential for a return to a more embodied, non-hierarchical, less predictable engagement with space akin to that of Indigenous culture. He writes that such devices 'show people their patterns in a way that might be directly useful and interesting to them, even suggest changes in behaviour and be able to measure and show direct changes in mood resulting' (1999: 13). Our actions no longer become just commodities to be analysed and harnessed by marketing firms or authorities, but instead placed in our own hands or shared with others. As a result, they make us reflect on our daily routines and interactions with others – in turn making us rethink and alter these patterns. One of the most intriguing sections of the document consists of Russell's account of his own autodidactic self-observation and monitoring through a series of different diary techniques. One involves daily entries consisting of 10 words that he would come up with in the evenings upon reflecting on the day. The first five words would describe 'practical' things, such as activities, events and exercise; the second five relate to 'abstract' things, like 'mood, people and sensations'. A sample entry he provides reads:

> 2.3.96 [date]
>
> climb.walk.work [practical words]
>
> sunlight.Carly.happy [emotive words] (Russell, 1999: 12)

Another concept consists of the 'pure mood log', which lists a number of categories relating to one's mood – 'boredom, fitness, health, how horny you feel, confidence' and so on – and rating each on a scale of -5 to +5. Viewing these entries over an extended period of time allows people to 'measure and show direct changes in mood' (1999: 13). These various methods of diary-keeping and mood-measuring are the most directly personal aspects of an otherwise often polemical document, and illustrate some of the everyday activities that might have inspired its author to write it.

The remainder of the text focuses on the ways in which ubiquitous GPS-enabled devices might transform

different aspects of society, from politics and political dissent to architecture, urban infrastructure and software development (for instance, open source projects like Linux going mobile). These arguments are put forward in typical manifesto-style, interspersing passages from selected texts that support Russell's worldview or provide 'evidence' of the changes he foresees happening accompanied by predictions and proposals about how they might unfold in real life. These range from the fanciful – 'if you know where a tree is and you know when someone is walking past it you could make it burst into song' (1999: 4) – to the almost prophetic – 'a world filled with notes and objects that aren't really there' (1999: 14). Russell's take on the potential of location-aware devices falls into the familiar techno-utopianist trap of over-optimistically predicting their impact and overlooking their potential to be co-opted by governments and corporations. His discussion of the tracking and tracing abilities of GPS focuses on how users will take advantage of location-specific information for sharing information about and reviews of places, keeping in contact with friends and organising activities and collective action. Less attention is paid to the surveillance and privacy concerns of these devices, although Russell does acknowledge the dystopian potential for government programs that store GPS location data (1999: 16) and the uneven possibilities they bring. As I discuss in the final section, though, in later versions of the text this development does attract more attention.

But perhaps more pragmatically, a similar critique made by Mary Flanagan of the Situationist International – a key inspiration for *headmap* – could be applied to Russell's vision. Flanagan's critique of the Situationist concept of psychogeography highlights how,

> as theorists, Situationists were bound by their time, place, class, language, and ethnicity, and may have failed to understand the *dérive* as an activity with race, class, gender, and ethnic implications. Theirs was also a class-specific view, in that they prioritized the autonomy of the individual who has unrestricted movement.
>
> (2009: 195-6)

In contrast, she notes that many people at the time did not have this privilege – the poor, homeless and marginalised – and that the Situationists' ideas seldom spoke to these people. Similarly, many of the utopian projects envisioned by Russell consist of activities to which only a relative few would have access: leaving messages on tress, overlaying urban space with symbols and 'electronic graffiti', creating playful games (who can get to the opposite end of town the quickest?). Only a certain professional class in generally progressive, democratic, predominantly urban and technologically-literate locations would be able to engage in such activities. Seldom are these arguably frivolous, naïve ideas challenged or problematised in the next, nor are external constraints – work, time, social pressures – factored into the scenarios envisioned in *headmap*. Of course, Russell accurately predicted many of the applications to which location-aware devices would be put – but as I discuss later these ultimately became subsumed by consumer devices. Before I get to this issue, though, it is necessarily to examine why this decidedly utopian, progressive thread is so dominant in *headmap*.

'The ability to mark and annotate real spaces will dramatically extend the possibilities for collective construction.'

Headmap shares much in common with other utopian visions of 'cyberspace' written in the late twentieth century that argued for an alternate world where networked technologies would lead to a complete restructuring of society. But it differed from other political manifestos and cultural representation of the internet from this time in two crucial ways. First, whereas most cyber-utopian texts depicted virtual and physical space as separate and distinct, the former liberating individuals from the constraints of the latter, *headmap* argued for an intersection of the two. It proposed the 'extension' and 'overlaying' of digital information in physical spaces; not a gradual transition from 'meatspace' into 'cyberspace' as was depicted in film and literature. Second, although other groups such as Mark Weiser's 'ubiquitous computing' research lab similarly advocated the merging of information technologies into physical architecture, they concentrated on consumer products created through private enterprise. *Headmap*, in contrast, focused on users' appropriation of these technologies, envisioning that most applications of location-aware devices would emerge through grassroots experimentation with them. These two factors make *headmap* almost unique in cyber-utopian discourse of the time, and further explain its subsequent influence on experimentation with location-based media. I will briefly elaborate on these two key distinctions in more detail.

The 1980s and 1990s were characterised by the anticipated imminent arrival of new organisations of society, politics and the economy made possible by cyberspace. This optimism was fuelled by texts like John Perry Barlow's 'Declaration of the Independence of Cyberspace' (1996), novels such as *Neuromancer* (Gibson, 1984) and *Snow Crash* (Stephenson, 1992) and, of course, films like *Tron* (Steven Lisberger, 1982) and *The Lawnmower Man* (Brett Leonard, 1992). These texts, as Julian Kücklich (2009: 341) notes, all portray cyberspace as both separate from the physical world and outside the reach of governments and traditional forms of state-controlled power. 'The common thread in these discourses of cyber-utopianism', he writes, 'is a tendency to regard virtual space as lying "outside" the territory of national states, and its "population" as exempt from the legislation of national states.' This sentiment was reinforced by popular and academic accounts of cyberspace during much of the 1990s, which were dominated by accounts of an 'exodus' from the material world towards networked virtual communities, complete 'with their own laws, economy, culture and institutions' (Kücklich, 2009: 341; see also Chun, 2006; Varnelis and Friedberg, 2008: 25-6; Zielinski, 2006: 40). *Neuromancer*'s 'matrix', for instance, is a lawless frontier governed by a 'super-AI' that eludes police control, while the 'Metaverse' in *Snow Crash* is a radically privatised virtual network with few controls or boundaries bar private ownership. Likewise, Barlow delivers a warning to 'Governments of the Industrial World' in his 'Declaration' that 'cyberspace does not lie within your borders. Do not think that you can build it, as though it were a public construction project. You cannot. It is an act of nature and it grows itself through our collective actions' (1996).

Headmap arrived at the height of this celebratory rhetoric surrounding the Internet. In some ways, it builds on the assumption common to these accounts that it is an inherently liberal, unifying technology whose decentralised architecture innately resists top-down, hierarchical control. *Headmap*'s description of location-aware technologies that make users more attuned to the physical environment around them, allowing them to augment physical architecture and objects with digital information and organise political dissent, taps into this tendency to inscribe the Internet with subversive qualities. But it also appeared at a time when the understanding of cyberspace as a spatially distinct realm, separate from the material world,

had for several years been extensively critiqued – at least in academic theory. Manuel Castells' *Information Age Trilogy* (originally published 1996-1998) had outlined in exhaustive detail the very material elements of the Internet and its embeddedness in physical infrastructure. In a perhaps dystopian (if not at least cautionary) corrective to the utopian ideals that characterised accounts of cyberspace at the time, Castells warns of the rapidly expanding gap he perceives between the 'space of places' and 'space of flows', roughly corresponding to physical space and virtual space respectively. 'Unless cultural, political, *and physical* bridges are deliberately built between these two forms of space', he writes, 'we may be heading toward life in parallel universes whose times cannot meet because they are warped into different dimensions of hyperspace' (2009: 459; original emphasis). Similarly, Saskia Sassen in her book *The Global City* (first published in 1991) describes the growing concentration of economic power in a select few cities – New York, Tokyo and London – linked through networked infrastructure. Despite their divergent histories, cultures, economies and political systems, Sassen argues that it is 'precisely because of the territorial dispersal facilitated by telecommunication' that these cities were able to develop parallel to one another and together come to 'account for a disproportionate share of all financial transactions' (1991: 5).

Both Castells and Sassen, then, dispelled the myth that cyberspace is both atemporal and spaceless. *Headmap* sits somewhere between the utopian literary visions of cyberspace and this more grounded understanding of the space of the Internet as materially bound and shaped. It retains elements of the romantic, idealised vision of the Internet from earlier accounts. But it also reflects this growing recognition within academic discourse that physical and virtual space are not separate, but closely interlinked. In this sense at least, it challenges previous ideologies that privileged cyberspace as a transcendental realm completely disconnected from physical space and time. It did, however, largely ignore the potential for governments, corporations and other forms of centralised power to regulate it (at least in its first iteration, as I outline in the final section of this paper).

Russell was not the only proponent at the time of blending physical and virtual space through computer technology. Eight years earlier, Mark Weiser had published his influential *Scientific American* essay, 'The Computer for the 21st Century' (1991). Weiser, who at the time headed the Computer Science Laboratory at the Xerox Palo Alto Research Centre (PARC) in California, was an early pioneer and proponent of the notion of 'ubiquitous computing.' Ubiquitous computing (also referred to as 'embodied virtuality') was based on the premise that although computers at the time required 'complex jargon' and technical expertise to understand and operate, soon they would become 'so ubiquitous that no one will notice their presence'. For Weiser, 'the most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it' (1991: 94). He criticised the dominant focus on desktop computers, contending that it perpetuated the idea that computers would occupy a specific place in the home or workplace and people's interaction with it would be confined to that space. This prevented computer technology from becoming a truly ubiquitous presence in people's lives. He predicted a 'post-desktop' future, in which computers will recede 'into the background' and 'embodied virtuality will make individuals more aware of the people on the other ends of their computer links' (1991: 104).

Headmap shares much in common with Weiser's desire to intermesh computer technology and physical architecture. There is even a fleeting reference to PARC's research in the 2004 'redux' version of the manifesto (see Russell, 2004b: 22). Nonetheless *headmap* envisions this process unfolding in a very different way to that of Weiser's research. Weiser was employed as the head of a research team dedicated

to finding ways of making computers more pervasive in the home. As such, his research was very much immersed in the consumer-driven mentality of Silicon Valley. As Paul Dourish and Genevieve Bell (2011: 9) note, Weiser's article was 'partly a manifesto and partly a progress report.' Its polemical language and futurist spin is reminiscent of earlier cyber-utopian visions of a future transformed by networked devices, but ultimately it contended that these would be delivered to consumers by global technology firms and small start-ups. *Headmap*, in contrast, predominantly focuses on the new possibilities that would be unleashed by the users of location-aware devices themselves and their creative experimentation with them. This distinguished it from already existing notions of 'ubiquitous', 'pervasive' and 'urban' computing, which as Galloway (2008: 185) points out, 'tend to be "top down" in the sense of originating in universities and corporate research labs.' Throughout *headmap*, there is an underlying assumption that the mere presence of these devices will automatically bring about the revolution Russell envisages; that the simple fact of their existence in the hands of everyday users means that they will disrupt the heretofore top-down, corporatised development of the Internet seen with the World Wide Web. This sentiment is expressed most clearly in the introduction, when Russell states that 'the internet has already started leaking into the real world. Headmap argues that when it gets trully [sic] loose the world will be new again' (1999: 5).

'Technology is a hard edged reality, but it is also a carrier of metaphors, and those metaphors are often as important as the devices themselves'

Remarkably, while location-aware technologies would eventually be co-opted by consumer applications (epitomised by the release of the iPhone 3G in 2008), Russell's vision *was* actually realised in practice. The *headmap manifesto* is cited by some theorists (Lenz, 2004; Tuters and Varnelis, 2006; Zeffiro, 2012) as a foundational text for what later became known as 'locative media.' The term 'locative media' was first coined by Karlis Kalnins during the Art+Communication Festival held in Riga in May 2003 (Zeffiro, 2012: 251). Drew Hemment notes that this moment 'brought together many early practitioners and played an important role in the emergence of the *field* of locative media' (2006: 350; my emphasis). The actual technology used by locative media artists and practitioners had existed for many decades, in the form of Global Positioning System (GPS) technology developed by the U.S. military. As Eric Gordon and Adriana de Souza e Silva (2011: 41-2) note, 'although GPS technology has existed since the early 1960s, it was not until the Clinton Administration removed the signal degradation called Select Availability (SA) on May 1, 2000 that these devices became popular.' As a result, GPS technology was made 'much more accurate, allowing users to locate specific places and objects on the globe's surface.' The widespread growth and accessibility of online digital mapping tools such as MapQuest (1996), OpenStreetMap (2004) and Google Maps (2004) also laid the groundwork for bringing commercial mapping and 'geo-locative' tools to everyday users. But Russell's prediction that amateurs and artists would conduct the most interesting experimentations with location-aware devices proved accurate – at least during its crucial early period.

It is not necessary to provide a definitive, or really even brief, overview of the different types of locative media art and projects that emerged during its zenith (generally considered between 2003-5, although locative media projects are still created today). Hemment's (2006) article in the widely known *LEONARDO* special issue on locative media gives a useful breakdown of the different types of projects, while other theorists provide taxonomies and histories of the movement and the multitude of projects it produced (see in particular Drakopoulou, 2010; Tuters and Varnelis, 2006; Zeffiro, 2012). It has also produced an entire sub-discipline of mobile media studies focused on locative media, led most prominently by American-

based scholars like Jason Farman (2012), Adriana de Souza e Silva (2006) and Jordan Frith (2015), but encompassing theorists from many other (albeit mostly Western) countries. This widespread uptake of locative media as both artistic practice and academic discipline can be traced to the history behind the development of the term itself – in which Russell's text played no small part. 'Locative media', as numerous theorists have pointed out (Galloway and Ward, 2006; Kalnins, 2004; Tuters and Varnelis, 2006: 357; Zeffiro, 2012: 251), is derived from the locative noun case in the Latvian language. It roughly corresponds to the English words 'in', 'on', 'at' or 'by' and refers to the final location or time of an action. As Kalnins (2004) explains, it is a decidedly apt term for location-aware devices that use GPS technology, given 'GPS devices are useful for not just geographical coordinates but also for obtaining very accurate time from orbiting atomic clocks', emphasising the fact that these devices (and the projects that use them) are 'not just about location'. The use of the Latvian case also nods symbolically to the locale at which the term itself was coined, neatly bringing everything back full circle.

Since its inception, then, locative media has been imbued with self-reflexive terminology and symbolic language that distinctly marks it as an intellectual, artistic and avant-garde practice. Evidence of this can be found from the clever coining of the term – which gave a previously disparate set of artistic practices a somewhat unifying direction – to the poetic, mostly optimistic language of Russell's manifesto. 'Locative media' encompasses not only the technologies and tools for location-based tracking, but also the mythical 'aura' around these devices that its practitioners and proponents espoused. This symbolic significance of the term is reinforced in Russell's definition of locative media in his introduction to the *Transcultural Mapping Online Reader*. He contends that

> Locative media is many things: A new site for old discussions about the relationship of consciousness to place and other people. A framework within which to actively engage with, critique, and shape a rapid set of technological developments. A context within which to explore new and old models of communication, community and exchange. A name for the ambiguous shape of a rapidly deploying surveillance and control infrastructure. (2004a)

Both Russell and Hemment's (see above) descriptions of locative media as a 'field', 'site', 'framework' and 'context' for understanding and 'critiquing' technological and social transformations underscores their advent as the arrival of a new movement, not merely a new set of technologies and devices. This was partly accomplished by distinguishing locative art from the new media art that came before it – namely, net art (sometimes stylised as 'net.art'). While net artists used digital technologies to create art works that participants could interact and engage with, they were generally confined to the computer monitor or showcased on a computer screen inside art galleries (Pearce, 2006: 73). By the late 1990s, Marc Tuters and Kazys Varnelis (2006: 358) note, net art had begun to show 'signs of exhaustion', with many art critics noting its boom had 'come to an end'. Soon after, locative artists began to fill this void, defining themselves against net art in two ways. First, they embraced consumer technologies such as mobile phones, PDAs and GPS-enabled devices, bringing new media art out of the gallery and into the public spaces of the city (Hemment, 2006: 351). Second, they were more willing to accept corporate sponsorship: Proboscis cited endorsements from clients such as HP and Orange UK, while Blast Theory openly acknowledged their acceptance of corporate sponsorship for their projects, as well as other public arts funding and university partnerships (see Tuters and Varnelis, 2006: 360; Varnelis, 2011). In this sense, many artists and proponents of locative media defined themselves as not unlike 'freelance Research and Development' teams (Cubitt, 2007: 1152), experimenting with new devices and putting them to unintended uses, just as

much as they were traditional artists. Both these arguments contributed to a rhetorical positioning of locative media as the 'forefront' of new media art, embracing new devices and taking interactive art out into the streets, in contrast to net art's 'confinement' to the gallery and computer screen. [5]

Headmap provided more of a conceptual inspiration for the practices that ultimately emerged out of locative media than a principled framework or handbook directly adopted by artists. Yet traces of Russell's utopian rhetoric and compelling vision of location-aware devices can be found in workshops, conferences and descriptions of artistic projects. South Korean artist Taeyoon Choi mentions *headmap* as a direct influence on his work in public space, [6] while projects like *Urban Tapestries* (Proboscis, 2002) and *dot.walk* (Wilfried HuJeBek, 2002) realised the grassroots possibilities for tracking and tracing people's movement through the city. Media scholar Anne Galloway even specifies *headmap* as the inspiration for her PhD dissertation on locative media and urban computing (see Galloway, 2008: 185). And in her genealogy of locative media, Andrea Zeffiro (2012: 253) cites the publication of Russell's manifesto, alongside the Art+Communication Festival in Riga, as one of the two 'defining moments of [its] emergence' (2012: 253). Artists took up its argument for an 'outside' rather than 'inside' worldview in spirit, making its call for a grassroots, amateur uptake of mobile, location-aware devices a tangible reality.

In this sense, *headmap* served as one of the key inspirations for the conceptual category of locative media, which subsequently subsumed existing artistic practices into one collective movement and spurred further experimentation and innovation. But it is worth noting that locative media as a critique and practice of location-aware devices was, and remains, highly problematic. On one level, it is subject to extraordinarily optimistic claims about its potential to reinvigorate public space, make participants and users more engaged with the people and environment around them, and get people outdoors in stark contrast to earlier forms of new media art (Tuters and Varnelis, 2006; Varnelis and Friedberg, 2008). In part, this is a legacy of *headmap*'s influence on the movement – a deliberately provocative manifesto whose celebratory rhetoric gets taken up uncritically by artists and proponents who identify with its vision of the world. Of course, many theorists and commentators did offer far more pessimistic and critical correctives to these optimistic declarations. These criticisms focus on the potential for location-aware devices to be surreptitiously tracked and surveilled by governments and marketers, most prominently represented by Andreas Broeckmann's oft-cited description of locative media as 'an avant-garde of the "society of control"' (see Dieter, 2014: 227; Flanagan, 2009: 190; Tuters and Varnelis, 2006: 360). But these claims were often equally as problematic as the optimistic accounts perpetuated by Russell and other advocates of locative media.

Broeckmann's statement was really a throwaway line in a discussion forum post intended more as a question regarding the 'ambivalence' about locative media noted by others than a scathing criticism. He writes,

> i [sic] have always understood the term "locative" as pointing in both directions, the potential for enriching the experience of shared physical spaces (as described by Marc [Tuters] in his mail), but also fostering the the [sic] possibility to "locate", i.e. track down anyone wearing such a device. (in Graham, 2004)

But Broeckmann's cutting phrase has since been immortalised, and is now often invoked by numerous other theorists who dismiss locative media as a military and consumer tool for hegemonic control. Most

prominently (and perhaps polemically) Brian Holmes (2004) argues that many locative media projects simply serve as 'proof of infallible performance by the satellite mapping system' despite their visual beauty. He accuses locative media practitioners of being at best uncritically oblivious to the military and consumerist origins of the technologies they use; and at worst wilfully introducing a more widespread acceptance of surveillance and tracking through their practices (2004). But the problem with critiques like Holmes's is that they often tend to be equally as hyperbolic and uncritical as the celebratory claims espoused by locative media's proponents they target, offering a similarly one-sided perspective rather than a more nuanced or 'ambiguous' one.

Headmap, then, influenced the formation of locative media as a conceptual category. But it also arguably contributed – if only in a marginal way – to the development of this rather binary, oppositional discourse around the term, whereby locative technologies are either embraced or dismissed. Certainly, there have since been invaluable scholarly contributions to the study of locative media that have unpacked its historical lineages in mobile communication and positioned it within broader understandings of everyday urban life. But a great deal of the discourse around it has fallen into either of these two camps – uncritically optimistic or uncompromisingly dystopian – with little middle ground between the two. This leads to an extremely abstract, overly rhetorical understanding of location-aware technologies and the artistic projects that have emerged from them. It ultimately comes at the expense of a more grounded critique with the actual, embodied experience of engaging with them or the institutional constraints and imperatives that shape their creation.

This is, arguably, *headmap*'s dual legacy. It provided a powerful vision of location-aware devices that emerged right at the very beginning of their mainstream development, inspiring a radical, avant-garde artistic movement dedicated to experimenting with them. But at the same time, its overtly utopian rhetoric led to a field of discourse that became highly contested and problematic, initially shaped more by promises and claims than an embodied critique of the technologies and practices around them. It was incredibly successful in spurring practical experimentation with location-aware technologies that might not otherwise have occurred. But it also generated equally as much myth and imaginary as productive critique.

'The world as interface.'

Locative media and the vision of location-aware devices perpetuated by texts like *headmap* are now a far cry from the applications to which these devices are predominantly put today. As I mentioned at the onset of this paper, Russell was actually remarkably accurate in predicting the kinds of commercial uses of GPS and location-aware devices that are now commonplace. *Headmap* predicts the rise of location-based social networks like Foursquare, restaurant and hotel review services like Yelp, location-based dating apps such as Grindr, and location-based games. And it does so in some instances well before their actual advent years later. But, as I have outlined in this article, *headmap* depicts these applications as primarily being driven from the ground-up, operated in an almost communal fashion at the highly local, community level. Instead, the services that exist today – Foursquare, Yelp, Grindr and even many location-based games – are operated by start-ups mostly based in California and entangled in the global app economy dominated by Apple and Google (see my discussion of this evolution in relation to location-based games in Leorke, 2014). On one level, this has allowed these applications to become far more widespread and closely ingrained in the everyday lives of users. Facebook and Google's capacity to create intricate databases of their users' social networks, coupled with the ubiquity of smartphone devices, has effectively made Russell's prediction

of a 'spontaneous extended community defined by both common interest and proximity' (1999: 4) a reality. But these are extremely commercialised applications: recommendations based on one's purchase history, 'gamification' and app stores with 'microtransactions' or in-app purchases do not figure in Russell's vision of the original 1999 *headmap*.

In fact, as subsequent iterations of *headmap* were published in 2002 and (circa) 2004, Russell's vision remains strongly utopian, rather than becoming more pragmatic. The 1999 version's utopianism does subsequently become somewhat counterbalanced by warnings that echo the dystopian anxieties about location tracking by theorists like Holmes mentioned above. In the 2002 manifesto, Russell cautions, 'if location aware devices reach the mass market in a form that does not cryptographically protect the user, governments and corporations are soon going to know exactly where everyone is in real time' (2002: 29; see also p. 22). But these fleeting warnings are dwarfed by an additional 15 pages of text devoted to exploring the relationship between location-aware devices and 1960s counter-culture. The final sprawling section attempts to trace a link between networked mobile technologies and counter-cultural practices. These include hippie communes; temporary autonomous zones (real and imagined pop-up communities like Burning Man, Archigram's Instant City and the Glastonbury festival); electronica and trance music; new age spiritualism; experimentation with LSD and other drugs; and the sexual liberation movement. Insisting the spirit of counter-culturalism is not dead, Russell argues 'the spatial and social weirdness that location-aware devices are going to make possible is prefigured by the spatial and social experimentation of the counter-culture' (2002: 38). For Russell in 2002, the endpoint of ubiquitous location-aware devices is now 'a digitally mediated 21st century extended commune' (2002: 48).

At more than twice the length of its previous iteration and three times the original, the (circa) 2004 'redux' version of *headmap* contains a far more expansive and structured analysis of contemporary developments (now with a fully numbered, albeit still incoherent, table of contents). But it is only very marginally less polemical and optimistic than previous iterations. Among its main new opening arguments is Russell's account of what he describes as an emerging state of 'nodishness', in which the distance between one's psychological and electronic, online identities is increasingly diminishing. People, he writes, are becoming 'mobile nodes', 'bound to their devices' but still embedded in physical space, entering into impromptu conversations with others and forming collective networks across territorial and cultural space (2004b: 4). The emergent platforms foreshadowing this process Russell identifies are blogging and Apple's Rendezvous technology (software released in 2002, and later renamed as 'Bonjour', that allows different devices to talk to one another). Blogs, he argues, will soon move away from static online texts containing mundane monologues about daily life and become a method for connecting to others through mobile, location-aware devices in a social equivalent of Rendezvous.

Crucially, Russell envisions this process, once again, as occurring inside but beyond the confines of commercial development: it will be 'adhoc-corporate but still cellular' and 'likely end up being something more than nokia or sony [sic]' (2004b: 3). On page 23 of the PDF (the page numbers are mixed up in this section), he posits a trend whereby using GEOURL (tagging websites with GPS information), individuals will be able to index items and services they are selling, thereby bypassing websites like eBay. He contends this will lead to a new 'gift economy', where people trade their possessions or perform tasks for others in exchange for money or favours in return: 'exporting successful internet models to physical reality'. [7]

Later in the text Russell does ruminate once again on the growing privacy concerns over locative

technologies, predicting (accurately) that

> people will almost certainly use location aware devices without strong privacy protection in place, as long as transactions are secure and there is no overt discernable [sic] violation. If it makes there [sic] lives easier Americans seem content to have huge market research firms keeping data on them and selling that data. (2004b: 56)

In a further prescient remark, he states

> if this technology impacts without privacy built-in, all kinds of organisations could not only know your internet browsing habits, but where and when you go (in real time – i.e. where are you now), what you buy and who you see, and from that establish the patterns in your spatial behaviour. (2004b: 56; see also pp. 66-7)

But ultimately the text remains unabashedly idealistic and optimistic. While the 2004 version much more explicitly acknowledges the path location-aware technologies will eventually follow – social networking, marketing and government surveillance – it still proposes amateur, anarchic and grassroots practices to counter this. It concludes with a 'revision note' which states how this is already happening – the aforementioned use of GEOURL to associate web content with individuals and geography – and declares that as location-aware technologies become more mainstream such practices 'will be easy for anyone' (2004b: 95).

It is no coincidence that the 2004 version of *headmap* was its final iteration. This is the point at which artistic experimentation with locative media was reaching its apex. Numerous conferences and workshops were being devoted to its application and study; seminal projects like Esther Polak's *MILK* had gained widespread attention (winning the Ars Electronica Golden Nica the following year); even the mainstream press was covering its developments (see for example McClellan, 2003; Stroud, 2002). But it was also just as the inevitable commercialisation of locative media had begun: 2004 was the year of Google Maps' launch, ushering in Google's dominance of the field, followed by Apple in 2008 and Foursquare in 2009. Tellingly, 2004 was also the year of Tim O'Reilly's Web 2.0 conference, popularising the concept of 'user-generated content' and its subsequent assimilation into the corporate strategies of technology companies around the world.

Rereading *headmap* today, it is clear that its predictions of future developments in location-aware technology are startlingly accurate. The 2002 manifesto includes a sketch of a prototype for augmented reality glasses not entirely dissimilar to Google Glass (p. 10; see description of device on p. 8). It also foreshadows the rise of services like Uber and Airbnb: 'drive cars that aren't yours and live in houses you don't live in' (2002: 7). The 2004 version, as mentioned, accurately predicts and cautions against the general indifference towards location-aware media's potential for surveillance and data mining that is now the norm. It also describes a simultaneously utopian and dystopian near-future where 'your view of the space and other people is supplemented by additional subjective annotation and symbolism' such as advertisements, directions and information about friends' activities' (2004: 7). This is essentially the vision promoted in Google's Glass promotional videos and parodied so brilliantly in Jonathan McIntosh's 'ADmented Reality' remix of one their ads. [8] But aside from these clever predictions and notable connections with the present, the world described in *headmap* is very different to the one we now inhabit.

As I have sought to emphasise throughout this paper, *headmap* – like many locative media artists following it – acknowledged the consumer and military origins of location-aware media. At the same time, it ambitiously argued for a widespread, amateur-led appropriation of them leading to the formation of ad-hoc communities and social networks outside the corporate structures and imperatives of these technologies. Needless to say, this has not eventuated on the scale envisaged at the time.

Of course, such communities and networks are formed every day on a small scale, using GPS technologies and mobile devices – geocaching being an excellent and still widespread example. But most people's daily experience with location-aware devices is in the form of smartphone devices with closed, highly controlled architecture and apps that generate profit either through up-front purchases, microtransactions, advertising or vast volumes of data collected from their users. The evolution of location-based media has followed much the same path as that of the World Wide Web – a technology that initially held the promise to revolutionise communication, political organisation and the dissemination of ideas that quickly became corporatised and assimilated into the logic of neoliberalism. The publication of the final *headmap* marks the turning point for location-based media: Google's entrance into the field, followed by a few more years of experimentation before tracing, tracking and location-based social networking become commonplace tools in commercial platforms. As a consequence, despite often being spot-on with its predictions about future developments, *headmap*'s vision of a future shaped by unanticipated applications of location-aware devices once they are placed in the hands of everyone has not been realised.

Probably *headmap*'s most visible, concrete legacy has been to describe – and to a certain extent inspire – the artistic practices that would later be cemented and critiqued under the rubric of the locative media movement. This movement is where Russell's ideas and vision were most practically realised: projects like Polak's *Amsterdam RealTime* (2002) and Blast Theory's *Can You See Me Now?* (2001), among many others, that took location-aware devices out into the streets of the city and constructed ways for individuals to gain a new understanding of the environment and their relationships with other people. Yet as location-aware technology has become increasingly commercialised and incorporated into the profit-generating structures of Apple, Google and Facebook, scholars have expressed dismay at the concurrent decline of artistic experimentation with locative media. Zeffiro laments the 'disjuncture between recent commercial "locative media" applications' and the more ambitious experimentation of only 'a few years ago' (2012: 250). Her comments echo others by Kazys Varnelis (2011) and Johan Brucker-Cohen (2014) that observe the growing gap between locative media art's radical early period and its present consumer appropriation. Of course, locative media art has by no means vanished entirely – Brucker-Cohen lists a spate of recent projects that 'call into question the very existence of the technology and social frameworks that underpin location-based technological systems' (2014), and new works utilising location-aware technology are still being produced today. But where once these practices were cutting edge, representing the forefront of experimentation with location-awareness, now they pale in comparison to the expansive incorporation of location-based services into commercial platforms from Facebook and Google to Twitter, Foursquare and Grindr with their countless users.

Yet the term locative media is alive and well today – perhaps even more so than the practice itself. As I mentioned earlier, the artistic projects that positioned themselves as part of this movement have in turn spawned an entire sub-discipline of 'locative media studies' within the broader field of mobile media studies. Entire books, edited collections and journal articles (including of course this one) devoted to the topic continue to be published almost as much as ever before, and numerous high-profile scholars have

built careers around its study. As the technologies and applications to which they have been applied began to move from the avant-garde into the commercial realm, the discipline evolved to reflect this shift. Initially some scholars were highly celebratory about the arrival of locative media in an attempt to describe their impact on everyday life, praising their capacity to reframe and reinvigorate users' relationships with the people and environment around them (see for example de Souza e Silva, 2006; de Souza e Silva and Hjorth, 2009). Now studies are predominantly devoted either to analysing people's use of smartphones and apps like Foursquare in their social relationships or retracing the legacy of early locative art.

Nonetheless, the term locative media has stuck, even though it is used almost exclusively in the artistic and academic domains – the everyday user of location-aware devices would not think of or describe them as 'locative media'. The term persists largely because it is perpetuated by scholars who have reclaimed it and transformed it into a vibrant academic field, despite the term itself seldom being used outside of the field. This reification and ossification of the term's lineage is evidenced most recently in the title of Jordan Frith's book *Smartphones as Locative Media* (2015), which clearly attempts to position smartphones within the historical trajectory of early locative art – even though for all intents and purposes the two have completely diverged. Tellingly, Frith's book hardly mentions locative art projects, concentrating primarily on smart phone applications, almost assuming that the two are synonymous. In this sense, locative media has come to almost transcend the material, embodied artworks and projects it began with. It has subsumed the practice itself, becoming a conceptual category for analysing them, just as Russell envisioned it (see his descriptor of the term quoted above, 2004a); albeit almost solely within the purview of academic discourse. Perhaps this is ultimately *headmap*'s most enduring legacy: contributing in a small way to the formation of a scholarly discipline that has arguably outlived the very concept it critiques. att This is not to slight locative media studies of course, which has contributed enormously valuable – and for me personally highly influential – studies of location-aware technologies and the movement more broadly. But it does reinforce my argument that *headmap*'s legacy has been primarily conceptual and discursive: it is more of historical importance as a window into how location-aware devices were thought of at the time than a roadmap for how they have actually been taken up. In true manifesto form, it provokes, inspires and sometimes influences developments, but its rhetoric falls far short of lived reality. Despite its canonical role in the formation of locative media and the subsequent take-up of location-aware devices by amateurs and artists, *headmap* and its author have since receded into the background. Following the publication of *headmap redux* on the headmap.org website circa 2004, Ben Russell seems to have largely withdrawn from web forums and public discussions of location-aware media and computing more generally. Likewise, the headmap collective's website is now defunct and an email I recently sent to their address went unacknowledged (although it did not bounce back). The technocult.org website, where *headmap* is currently archived, points out '[Russell] seems to have disappeared from the web around 2005.' It quotes one tech commentator, Tish Shute, who declares, 'the prime mover of the Headmap manifesto, Ben Russell retired from the scene – perhaps bored by seeing a radical vision gone thoroughly mainstream.' [9] Or more likely, as I have suggested, he saw the writing on the wall after 2004 and decided to retire the manifesto after accepting the inevitable commercial appropriation of location-aware devices that has now eventuated.

It would be nice to think that *headmap* still remains valid today, and that its call for a user-led appropriation of location-based media and content is still realisable. But current developments suggest otherwise. The chances of locative media experiencing some kind of resurgence are slim. Apps like *Pokemon Go*, despite their widespread popularity, merely perpetuate the appropriation of location-aware technology by the

digital games industry as a means to capture users' time and money in the 'attention economy' of smartphone apps. And despite initiatives aimed at incorporating citizens into the urban planning process and going against the top-down, bureaucratic management of cities, the dominant trend is now towards 'smart city' planning – which as theorists like Adam Greenfield (2013) and Rob Kitchin (2014) note is primarily vendor-driven, technocratic and based on visions that are more conceptual than pragmatically realisable. There are instances where Russell's vision resurfaces in contemporary debates and practices, or gains new relevance. More pertinent than ever is his observation that 'cities have scaled up so that more and more people live in them, but the people in them are further apart than ever…there are opportunities to help and be helped, to exchange or share, that the bluntness of our current social interfaces exclude' (2002: 9). But these amusing connections between contemporary developments and Russell's text aside, the future envisioned in *headmap* is, paradoxically, both tangibly close to our own present reality and even more distant and unrealisable than it was when it was first published.

Conclusion

In December 2015, Berlin-based artist Julian Rosefeldt's exhibition *Manifesto* premiered at the Australian Centre for the Moving Image in Melbourne. The exhibition consists of thirteen screens situated around the gallery space, some separate, others adjacent to one another. Each screen shows a different film, featuring actress Cate Blanchett reading out a series of well-known manifestos from the twentieth century juxtaposed with a performance that undercuts, comments on and recontextualises their radical rhetoric and premises. One depicts a classroom of junior school students being taught Lars von Trier and Werner Herzog's principles of filmmaking by Blanchett-as-schoolteacher. In another she plays a deranged homeless man shouting Situationist musings while wandering amongst the rubble of a post-revolutionary cityscape. Walking around the exhibit, I couldn't help but wonder how *headmap* would be refracted through this prism of retrospective reevaluation and reframing. Would its predictions of greater social and sexual intimacy seem facile juxtaposed with images of couples immersed in their smartphone screens while on dates, or people running into each other on the street because they are paying more attention to their phones than the people and objects in front of them? Or would Domino's and Amazon-branded drones swarming in the spaces between skyscrapers delivering products while broadcasting advertising messages tailored by local demographic data through loudspeakers seem a logical extension of the consumer potential of these devices predicted by Russell?

In many ways, *headmap*'s publication is still too close to our recent past to say decisively one way or the other. Despite the extraordinary leaps in GPS technology and location-awareness that have occurred since its first appearance, it remains a part of our recent history. Its vision continues to persist in academic and artistic discourse – and in practice, such as works by artists like Keith Armstrong, Sophia Brueckner and Mark Shepard to name just a few. But the radical vision it put forward has been firmly closed off, in favour of a much more conservative, consumer-oriented uptake of location-aware devices. The reality, though, is that *headmap* is no different than the innumerable manifestos published over the centuries: an expression of a moment, a desire, that may never be realised but remains as a powerful remnant of an idea that nonetheless shaped and altered – if only slightly – the thinking of the time. *Headmap* is, strangely, a simultaneously realised and unrealised vision: it did influence a number of artists and at least partially aided their formation into the locative media movement. But the practical output of this movement, along with Russell's manifesto, largely failed to live up to the hype and rhetoric, exposing some deep contradictions in the process and eventually being co-opted by mainstream culture.

The aim of this paper has been to outline and critique the discursive claims that circulated around location-based media – and especially those perpetuated by Russell in *headmap*. It highlights a time when the potential of locative media had not been fully realised, and was still open to new possibilities and unforeseen developments. When dealing with any new technology or set of technologies, it is important to analyse and dissect these discourses as much as possible, to identify the gap between the rhetorical claims surrounding them and how they are actually taken up and adopted by users. This is especially the case when dealing with highly celebratory, manifesto-style documents like *headmap*, oriented towards provoking new actions and ways of thinking by enthusiastically demonstrating what the future might (or should) be like. But by revisiting *headmap* I also hope to demonstrate how locative media was initially mobilised as a powerful political tool, through both the rhetoric of Russell and the practices of a multitude of artists around the world that it inspired directly or indirectly. While it is virtually impossible to recapture this initial wave of enthusiasm and possibility, today traces of them are more than ever an inseparable part of the everyday lives of people in many parts of the world. For future developers and users of these technologies, the arguments made throughout *headmap* that I have outlined in this paper remain as pertinent as ever – even if the circumstances around their development have since changed irrevocably.

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Biographical Note

Dale Leorke recently completed his PhD in the School of Culture and Communication at the University of Melbourne. His thesis examines location-based gaming and play in public space, critiquing the discourse around games and artistic projects that use mobile and location-aware media devices to bring digital play into physical spaces. His most recent work can be found on his research page: http://unimelb.academia.edu/DaleLeorke.

Notes

[1] There have been a few short analyses of the text on several blogs over the years; one of the better ones can be found here: http://www.sirc.org/articles/know_your_place.shtml

[2] The first, second and fourth quotes serving as sub-headings here are from Russell (2009); the third quote is from Russell (2004a).

[3] In 2002, an expanded version of the original text was released with the title *headmap localis(z)ation* followed by a further expanded 115-page version called *headmap redux* circa 2004. In this paper I predominantly focus on and quote from the original 1999 text, although I discuss the differences between this and the later versions in the final section. These texts were originally published on the now defunct headmap.org website. See http://technoccult.net/technoccult-library/headmap for an archive of the various editions.

[4] See Guy Debord's (1958/2006) account of the urban sociologist Paul-Henry Chombart de Lauwe's

diagram mapping a student's movements through Paris over the course of one year, 'pathetically limited' to three points (her university, accommodation and piano teacher's residence) with little deviation.

[5] Of course, as Hemment (2006: 351) points out, many locative media projects consisted of abstract representations of people and spaces on a screen, or were primarily experienced as maps and visual representations in art galleries rather than embodied outdoor experiences. This is just one of the many contradictions in the discourse around locative media.

[6] See http://www.momentarium.org/dialog/choi/

[7] Interestingly, platforms like Taskrabbit can be seen as realising this vision, although it is a far more commercial service than those that Russell envisions, which are based on mutual need and common interests rather than solely profit-making. Uber and Airbnb, both also foreseen by Russell as I mentioned shortly, fall into the same category.

[8] See https://www.youtube.com/watch?v=_mRF0rBXIeg

[9] Source: http://technoccult.net/technoccult-library/headmap/

[10] See http://lbutler.github.io/MelbParking/

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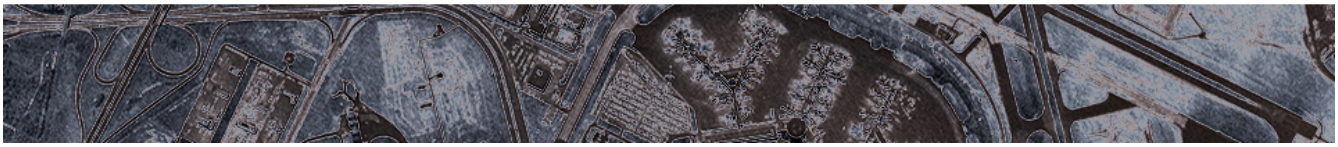

FCJ-217 Socio-Technical Imaginaries of a Data-Driven City: Ethnographic Vignettes from Delhi

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Abstract: As an imagination, the 'smart city' is rapidly becoming an integral part of our urban futures. Situated in the contemporary moment of 'data revolution' and India's techno-urban context, this paper is an attempt to reflect upon the socio-technical imaginaries of data-driven urbanism and the incumbent reconfigurations of how we know, experience and govern a city. The author provides ethnographic vignettes of five little traditions of data-driven urbanism in Delhi pertaining to: the new 'image of the city', the changing nature of expertise, civic data activism, data-driven consumer applications and political communication and analytics. Foregrounding the generative potentials of each of these socio-technical sites, the paper argues for a meta-analytics of data.

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> Several decades from now cities will have countless autonomous, intelligently functioning IT systems that will have perfect knowledge of users' habits and energy consumption, and provide optimum service … The goal of such a city is to optimally regulate and control resources by means of autonomous IT systems.
>
> (Siemens Corporation cited in Greenfield, 2013: 12)

> Do you, as a city, objectify the most sophisticated knowledge in a physical landscape of extraordinary complexity, power and splendour at the same time as you bring together social forces capable of the most amazing socio-technical and political innovation?
>
> (Matthew Fuller, 2012)

'Smarter Solutions for a Better Tomorrow' was the tagline for the 1st Smart City India Expo organised in Delhi, 20-22 May 2015. Ravish Kumar, a veteran Hindi journalist, covered the expo in his popular television news show. During a 'City Surveillance Project' demo, as a techno-manager tried to explain various aspects

like CCTV monitoring, vehicle tracking, command and control, data management, etc., Ravish interrupted to ask: 'What is this data management?' [a rough translation from Hindi]. 'Suppose you're driving a car,' replied the techno-manager, 'and you're stuck in traffic, only you know about that traffic and there is no centralised information about it. With a new sensors-based centralised command system integrated with the entire city's dynamic map', he continued, 'we can collect all the data, process it in real time and send you a message on how to avoid the traffic.' At this point Ravish, who was intrigued by the idea of a smart city throughout the show, asked 'how… as the number of cars on the road won't suddenly decrease.' (Kumar, 2015)

Beyond the questions of efficacy, this project demo along with several other demos at the expo, demonstrated new levels of enthusiasm and optimism in generating, mobilising and assembling certain forms of technologically empowered – especially 'data-driven' – urban futures. At a time when the Indian government has started to invest heavily in creating one hundred smart cities to solve pertinent problems of infrastructure, migration, employment, quality of life, delivery of services and governance (Ministry of Urban Development, n.d.) [1], the term and the networks of concepts which interweave its imagination call for scholarly attention and intervention. Much of the debate on smart cities in India has been focused on questions of policy and civic participation. The lack of clarity in the government's vision and conceptualisation has been severely criticised. (Lakshmi, 2015) However, there has not been much attempt to situate the idea of a smart city in India's techno-urban context, and reflect on its interconnections with the past, existing and imagined forms of data-driven solutions.

While smart cities are just the latest entrants into the vibrant, ever-evolving theatre of techno-urban problem solving, the wide-ranging potentialities which this term evokes – despite its conceptual fuzziness – have added new vigour to the discourse on urban infrastructures and techno-cultures both in India and abroad. (Khanna, 2012; Townsend, 2014) How do we then begin to unpack the umbrella term 'smart cities'? There cannot be one correct approach to this question, as it involves a panarchic (opposite of hierarchic) analysis of diverse sectors, institutions and actors. Given the current value-loaded and normatively techno-optimistic discourse, perhaps it would be worthwhile to start reflecting upon broadly what constitutes a smart city.

One fundamental aspect of smart cities is their 'data-driven' character and the relationship of this with the larger big data discourse. [2] As we embrace the 'data revolution' – which promises to transform knowledge production, business and governance through use of digital tools, techniques and infrastructures for analysing the ever-expanding data from our devices, the Internet, governments, etc. – data or rather data-drivenness is being increasingly viewed as technologically and politically vital for making cities smarter. This data-driven-ness, however, is not just a digital upgrade, enhancement or optimisation of our present infrastructures, practices and planning processes. Rather, like previous technological interventions in general, it reconfigures our epistemic and ontic formulations of a city. (Offenhuber and Ratti, 2014; Thrift, 2014) In other words, *data-drivenness* is reformulating the ways of *knowing, experiencing and governing a city*. This paper is essentially an exploratory, ethnographic engagement with these potential reformulations.

I will begin by introducing the research agenda. In the next section I will discuss the techno-urban context in India. Subsequently I will present some vignettes from my on-going ethnography of data actors or 'data-drivers' in Delhi to highlight possibilities of grounded inquiries into data-driven systems. I will conclude by

arguing for meta-analytics of data.

Introduction: Data-driven imaginaries

The burgeoning socio-technical research on big data has shown that questions and concerns about data quality, objectivity, epistemology and ethics are also themselves quite big. (Boyd and Crawford, 2012; Kitchin, 2014a) The colossal hype around big data and the data revolution, at one level, is part of our recent 'hype-cycles' of technology – in which every new set of technological innovations is greeted by unchecked optimism, and a more balanced view emerges only after cycles of failures in bringing about the expected 'revolutions'. (Gartner Inc., n.d.) At a deeper level, the big data debates invite us to reflect upon the history and anthropology of probability and statistics, computing and media, and quantitative social sciences. (Desrosières, 2002; Halpern, 2014; Gitelman, 2013; Manovich, 2013; Mattern, 2015) Cities provide a rich socio-technical context for the latter set of inquiries.

A well-networked city is the most fertile space for imagining big data or data-driven applications in general, since they require connectedness between various databases, institutions and socio-technical systems of transport, health, weather, water, sanitation, security, education, and governance. It is not a coincidence that the smart cities discourse has emerged in a certain conjunction with the data revolution, that is, the digital affordances of big data analytics, spatial data analytics, machine learning, data visualisation, etc. While there are longer histories of techno-urbanism, and specifically histories of the way that information and commutation technologies (ICTs) have been used to make cities 'wired', 'digital', 'cybernetic', 'networked', and 'intelligent', the data revolution marks an important shift from the earlier approaches and paradigms .(Graham and Marvin, 2001; Kitchin, 2014b) In the smart cities cosmology, ICTs – from desktops to remote sensors, and mobile phones to CCTVs – are imagined to be *ubiquitous, platform technologies* that collect and collate massive amounts of data, which could be analysed to make the city more 'knowable' and 'controllable' .(Offenhuber and Ratti, 2014) And even though data analytics per se has been part of the pre-big data analytics paradigms, its primary sources were limited to social and economic datasets. The smart cities movement, on the other hand, is anchored in the proliferation of digital spatial data which is being collected through GIS systems, sensors and user generated, geo-tagged social media content. (Shelton et al., 2014)

A critical engagement with this emerging shift in the epistemic and material basis of urbanism, I would argue, is only possible through an eclectic mix of conceptual tools and frameworks of science and technology studies (STS), urban studies, new media and anthropology. Cities, as Graham and Marvin and several others have illustrated, are complex 'sociotechnical hybrids' – wherein the technological and the social seamlessly co-evolve and co-construct each other. (Graham and Marvin, 2001; Coutard and Guy, 2007; Aibar and Bijker, 1997; Farías and Bender, 2009) Using this as a point of departure, I will reflect upon the emerging urban data assemblages in the Indian context.

Given the lack of precedence and overwhelming scope for such an inquiry, I will attempt to ethnographically engage with some common threads which run through the data revolution discourse – socio-technical imaginaries of data-driven systems. Drawing from interviews and participant observations from my fieldwork in Delhi, and extant literature, I will try to touch upon some of the historical and emergent techno-urban conditions and map the key sites for ethnographic inquiry. The choice of ethnography as a method to gauge socio-technical imaginaries of a data-driven city, goes beyond the need

for reclaiming the 'urban' from technological determinism. More importantly, it allows for a contextual engagement with generative potentials and affordances of digital technologies and infrastructures (Boellstorff, 2012; Coleman, 2010; Larkin, 2013), which otherwise get encapsulated in social imaginaries.

Political and social theory have elaborate conceptions of the intersubjective imaginaries which construct social order and practices. Arjun Appadurai, for instance, wrote in his seminal essay "Disjuncture and Difference in the Global Cultural Economy" (2002) that 'the world we live in today is characterized by a new role for the imagination in social life'. He argued that to understand this new role we need to revisit the old ideas of images:

> especially mechanically produced images (in the Frankfurt School sense); the idea of the imagined community (in Anderson's sense); and the French idea of the imaginary (*imaginaire*) as a constructed landscape of collective aspirations, which is no more and no less real than the collective representations of, Emile Durkheim, now mediated through the complex prism of modern media … the imagination has become an organized field of social practices, a form of work (in the sense of both labor and culturally organized practice), and a form of negotiation between sites of agency (individuals) and globally defined fields of possibility. (Appadurai, 2002: 49)

Appadurai's argument is critical for understanding the heterogeneity of modernity and the dynamics of globalisation. However, as Sheila Jasanoff points out, he does not 'engage with the seminal role of knowledge and its materialisations in generating and anchoring imaginaries of social order'. (2015: 12) Science, technology and media – the material basis of knowledge production and circulation, she argues, are 'inexplicably' missing from the overall social scientific imagination of imaginaries. To bridge this gap, Jasanoff puts forth a concept of socio-technical imaginaries, defined as 'collectively held, institutionally stabilized, and publicly performed visions of desirable futures, animated by shared understandings of forms of social life and social order attainable through, and supportive of, advances in science and technology'. (2015: 6) Socio-technical imaginaries, she writes, 'pull together the normativity of the imagination with the materiality of networks'. (2015: 28)

Conceptually, socio-technical imaginaries are germane for studying data-driven systems. Although data is today popularly conceived of as new oil or new soil, it is not simply available as a natural resource. As Lev Manovich wrote nearly a decade before the invention of the concept of the data revolution, data 'has to be generated. Data creators have to collect data and organize it, or create it from scratch. Texts need to written, photographs need to be taken, video and audio need to be recorded. Or they need to be digitized from already existing media'. (1999: 4) Data collection and generation techniques have undoubtedly become more sophisticated in the last fifteen years, but the basic principle still applies. As Lisa Gitelman wrote in the introduction of *Raw Data Is An Oxymoron* (a phrase coined by Geoffrey Bowker), 'Data need to be imagined *as* data to exist and function as such, and the imagination of data entails an interpretive base'. (2013: 3) Different disciplines, as many STS scholars including Gitelman have demonstrated, contextualise or cook and savour data as per their historically and culturally contingent epistemologies. (Gitelman, 2013; Bowker and Star, 2000; Edwards, 2010) With data-driveness expanding its publics into wider socio-technical realms like cities – in hybrids of human perception and cognition, computational logics of algorithms, databases and burgeoning digital infrastructures – the interpretive base(s) are encoding new socio-technical imaginaries and vice versa. The paper is intended to open up questions on these new forms of co-encoding or co-construction.

Indian Techno-Urban Context

Postcolonial cities have had numerous interesting encounters with socio-technical imaginaries of 'modernist urbanism', 'modern infrastructural ideal', 'post-industrial city' and so on. (Chatterjee, 2004; Graham and Marvin, 2001) Each of these imaginaries has been marked by various technological, infrastructural, spatial and political reconfigurations. For instance, Partha Chatterjee (2004) observed that in the post-liberalisation economy flooded with images of global cities circulating through 'cinema, television, and the Internet as well as through the Indian middle classes' far greater access to international travel' (143-144), government policies were increasingly designed to attract foreign investment. This created a situation whereby the urban middle-class citizens escalated their demands for 'unhindered access to public spaces and thoroughfares and to a clean and healthy urban environment'. (Chatterjee, 2004: 143-144) Simultaneously, the government policy quickly moved away from welfare for the urban poor, towards more investments in infrastructure to promote 'imports of high technology and the new service industries'. This had many visible effects including manufacturing industries being moved outside the city limits, eviction of encroachments, revisions in laws favouring the creation of high-value commercial and residential districts.

Chatterjee remarks that 'if this is the new global bourgeois vision of twenty-first century urbanity then this time we may have successfully grasped it'. (2004: 144) These reconfigurations however, were accompanied by a spate of unexpected implications as well. As Ravi Sundaram in his distinctive account of Delhi's media urbanism notes:

> The technological sublime of the planner imaginary, so central to post-independence India, began giving way to a splintered urbanist sprawl in the main metropolitan cities. Planning bodies pushed for the privatized decoupling of infrastructures; transportation design privileged the automobile flyovers and private toll highways to facilitate rapid travel to the suburbs, and private builders took over from older, albeit limited concerns with social housing. (Sundaram, 2009: 5)

Later he continues:

> ... the end of the state's technological monopoly opened up a dynamic space where the existing networks of 'political society' and expanding informal media production quickly moved from a model of parasitic attachment to a vitalistic transformation of the urban fabric. (Sundaram, 2009: 174)

These political-infrastructural transformations are parts of the genealogy of the contemporary push for ICTs for urban development and data-driven urbanism in India. Drawing longer and thicker connections between the postcolonial city and the smart city will remain a work in progress; however, it is worth noting that the dynamic interactivity between social imaginaries and their materialisations is a part of urban (and not just digital) ontology.

It is also important to note that 'splintering' in the Indian context happened without our cities ever achieving the 'modern infrastructure ideal' of universal, uniform grids and networks that covered services like water, electricity, roads, etc. Informal circuits, contested spaces and complex interactivity in co-existing systems of governance and infrastructure have long rendered the built environment in Indian cities some

peculiarities which are hard to grasp and account for in urban masterplans and policies. (Benjamin, 2008; Sundaram, 2009) The 'archipelago' (Bakker, 2003) condition of infrastructure systems calls for a view beyond the 'modern infrastructure ideal'. (Furlong, 2014)

For instance, in his ethnography of the water supply system in a suburban settlement in Mumbai, anthropologist Nikhil Anand analysed how the settlers manage to get access to water by mobilising 'pressures of politics, pumps and pipes'.(2011: 560) Anand shows that constant negotiations and 'pressure' politics between the settlers, their elected representatives, local dadas (powerful patrons) and social workers, and the engineers and hydraulic infrastructure, constitute what he calls 'hydraulic citizenship': 'a form of belonging to the city enabled by social and material claims made to the city's water infrastructure'. (Anand, 2011: 560) Anand sees this as being produced in a sociotechnical field through 'diverse articulations of *technologies of politics* (enabled by laws, politicians, and patrons) and the *politics of technology* (enabled by plumbing, pipes, and pumps)'. (2011: 560, my emphasis)

Anand's formulation helps in opening the largely black-boxed Indian cities as sociotechnical fields of interaction where infrastructures and politics materialise each other indeterminately. There are no similar ethnographic accounts of digital infrastructures, which arguably have much more convoluted and exotic issues of scale, multiple layers of abstractions, affordances and representation.

Nonetheless, we do know that the much-desired data-driven systems of the smart cities will have to co-exist and interact with the present infrastructure systems. [3] While data-driven imaginaries boast of integrated modes of knowledge production, the infrastructural conditions will possibly only allow new and old systems to co-produce hybrids which are driven by more things than data alone. (Bhatia, 2015; Lakshmi, 2015) For example, the Delhi metro – a rare, smoothly functioning infrastructure system in India – smart card data can be analysed to understand the commute patterns in the metro but the rest of the transport data in Delhi is extremely difficult to imagine, collect and collate with the metro data. These ambiguities, as we can gather from postcolonial urbanism and politics of infrastructure, are features (and not bugs) of the Indian techno-urban context, and can perhaps only be grasped through grounded inquiries.

Towards an Ethnography of Some Urban Data-Drivers

An ethnographic study of an Indian smart city will have to wait until the government, big consultancies and real estate moguls succeed in building one. Nonetheless, data-driven urbanism is thriving at the level of 'the imagination' in multiple forms. If we take smart cities to be a 'great tradition' to be performed by the government and partner agencies, there are several smaller entities performing diverse 'little traditions' of data-drivenness. (Singer, 1972) I will provide ethnographic vignettes of five little traditions or emergences that I have come across in the past six months of my fieldwork in Delhi. These are: a new 'image of the city', the changing nature of expertise, civic data activism, data-driven consumer applications and political communication and analytics. Whether data-driven systems can produce holistic, nuanced knowledge of the social is contestable; nonetheless, they increasingly are producing some form of knowledge of the 'social', and by implication reconfiguring the social. This, I will conclude, begs for ethnographic attention.

Emergence i. A new image of the city

Delhi is one of the very few cities in India with completely digitized maps and a Geographic Information System (GIS) in place – a pre-requisite in the selection of smart cities. During a recent visit to the government agency's office which manages Delhi's spatial data, one of the analysts gave me a demo on how their data can transform policy-making.

Their spatial data has 386 layers of map data, including locations of post boxes, public conveniences, dustbin and garbage dumps, schools, hospitals, transport, markets, water tanks and so on. [4] On his computer, the analyst mashed up different map layers to demonstrate how he can with a mere click of a mouse generate insights about the city's water bodies, roads, gas pipelines, forest and residential land zones, schools in a particular radius from any point on the map, and the list goes on. He regularly zoomed in and out of the map to explain the granularity and scale of their data. This non-real time data is currently only accessible for select government departments for planning and policy-making.

An internal case study of the project gives an account of the data collection process:

> The Department of IT gathered inputs from each participating line department and built every component of the project from scratch. The base map was created through the photogrammetric procedures on a large scale (1:2000), using aerial photography substantiated by various kinds of field surveys, namely topographic survey, property survey of dwelling units, underground utility surveys (including water, sewer and energy utility) and field photography in order to generate textures for the 3D models of the buildings. At the peak of the project execution, close to 1000 field surveyors were deployed. (PricewaterhouseCoopers, 2014: 6)

The project was commissioned in 2008, and in 2011 the Delhi government created an act to set up the agency which currently manages the data. In contrast to the rigor with which the spatial data was collected, until now only a handful of applications have been created for intra-government usage. The smart city project however, has created a new wave of enthusiasm in an office which is accustomed to only mundane processes of digitising updates to maps and seldom shares information with other government departments.

The analyst's elaborate presentation and use of different functionalities of his ArcGIS software (like zoom, projection, overlaps and distance calculations), made me stumble upon how spatial data has, and continues to, rework our perceptual field of the city, or to use Kevin Lynch's phrase, creates new 'imageability'. In his pioneering book *Image of the City,* Lynch writes,

> environmental images are the result of a two-way process between the observer and his environment. The environment suggests distinctions and relations, and the observer – with great adaptability and in the light of his own purposes – selects, organizes, and endows with meaning what he sees. The image so developed now limits and emphasizes what is seen, while the image itself is being tested against the filtered perceptual input in a constant interacting process. (Lynch, 1960: 7)

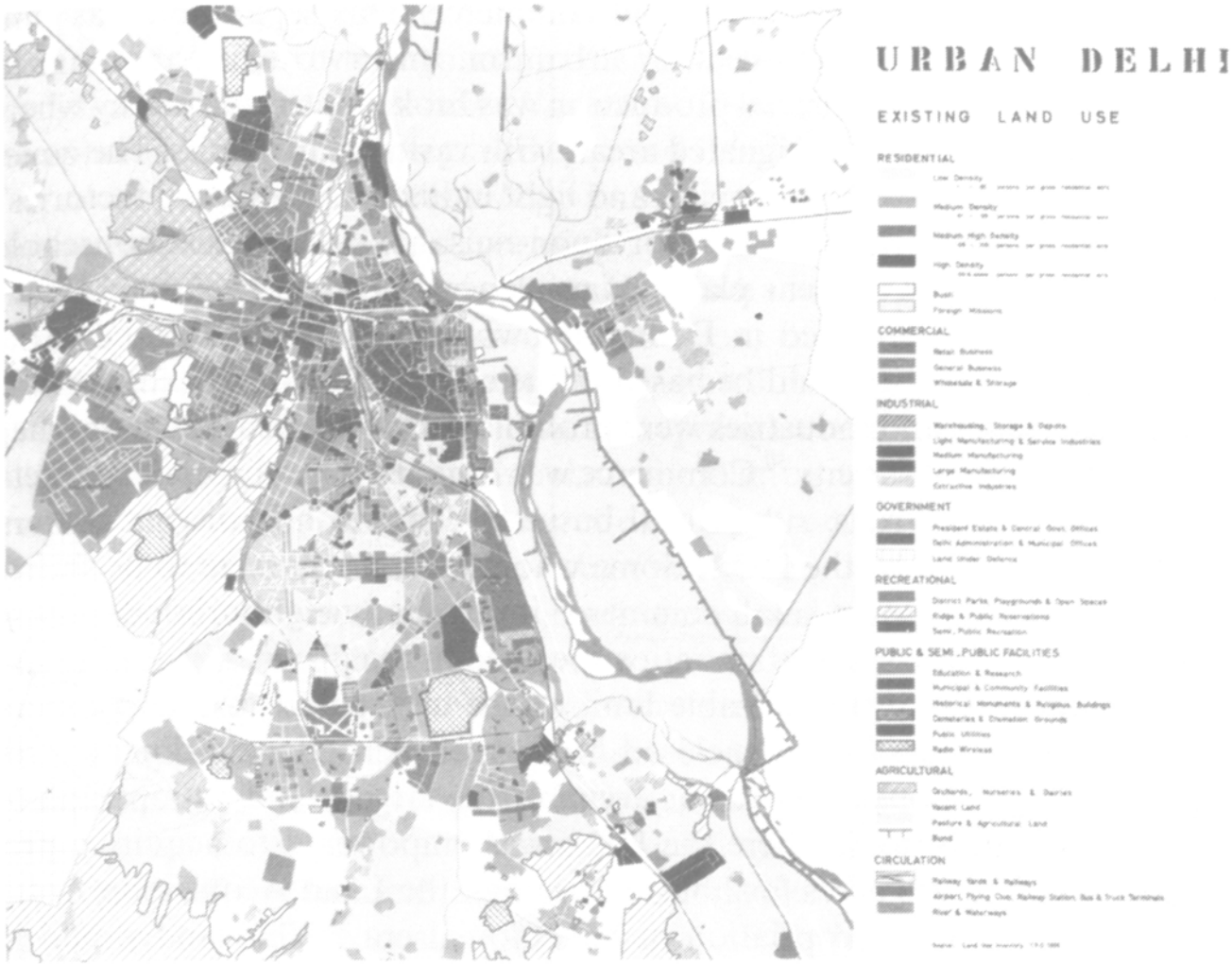

Figure 1. Map of Delhi, 1962. Source: Masterplan for Delhi, as cited in (Sundaram, 2009: 50).

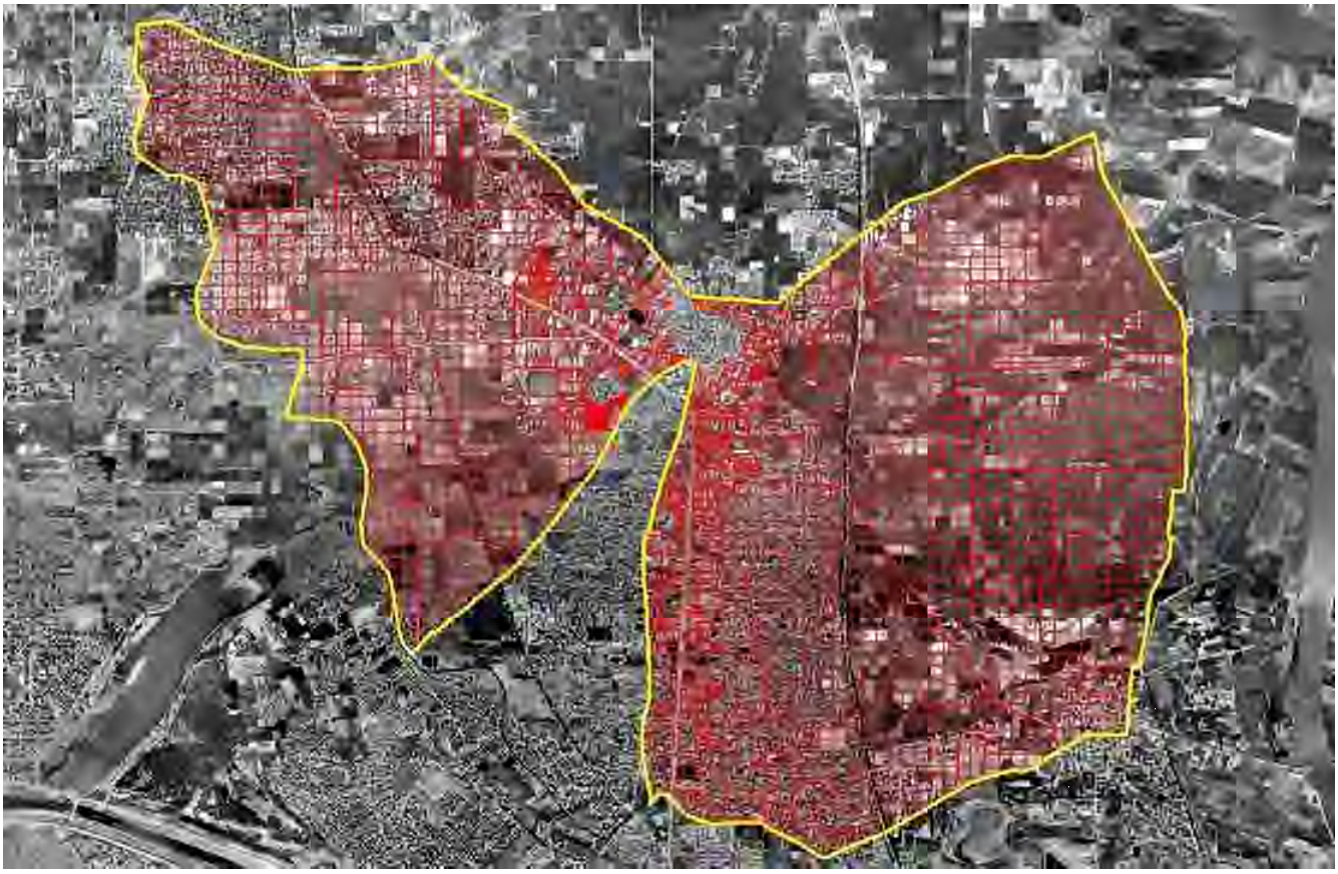

Figure 2. 'Vector Overlay on Ortho Image' (sic). Source: Geo Spatial Delhi Limited.

Software now, is an active techno-media layer of what Lynch referred to as 'environment'. The Google maps in our smartphones and the government's GIS, at different levels, provide the fundamental affordances for a new image of the city. This new heavily mediated image marks a new relationality between the observer and the city and participates in co-construction of a new techno-urban sensorium. For example, consider the two images above. The first one is the aerial map of Delhi in 1962, and the second one is a digital image on which a vector layer is overlaid on top of an 'ortho' base layer to highlight a particular area in the map using software. The latter image, the government analyst suggested, is an example of how spatial data can make the city 'transparent' and 'computable' for him. A critical geography of the augmentation being *performed* by the analyst might provide a different perspective. (Graham, Zook and Boulton, 2013) Nonetheless, this new image and its meta-images are reconfiguring how the analyst or any spatial data user – at different levels of technological affordances – can now visualise, know and experience the city. This reconfiguration is one of the foundational elements of the socio-technical imaginaries of a data-driven city.

Emergence ii. Expertise and data – who is driving whom and where?

'Planning now is not related to space. ICTs and sensors do not need space. We just need more tech', said a consultant working with the government on the smart cities project, as a response to my question on how they will manage to re-develop existing cities to smart cities. Beyond the obvious platitude, his response holds deep anthropological significance.

Several STS scholars, including Timothy Mitchell, have demonstrated how 'expert knowledge works to format social relations, never simply to report or picture them'. (2002: 118) In case of data-driven systems, it is difficult to trace the imaginaries and practices of its key drivers – techno-managerial experts, due to

limited ethnographic access in corporate spaces like the consultancy firms at the fore front of smart cities projects. Nonetheless, through my interactions with some techno-managers at these consultancies and with several data scientists (mostly engineers) at data science meetups, I have come across certain aspects of the expertise driving the smart cities and the big data movement in India.

Urban planning and policy have always depended on data. However, with the advent of big data, there is now a tremendous urge to collect more and more data. In my conversations with some leading urban researchers based in Delhi and Bangalore, I learned that instead of using the existing data, the current working of government agencies suggests an indiscriminate data collection approach without any sector-specificity or target. Also, I was told that there is a dearth of experts who could actually mine and analyse all the data we currently have.

This is also relatable from the fact that there are almost no university courses in India in the fields of engineering and management which teach data sciences per se. For example, an engineer might know how to program in R language or with NoSQL databases but they would most likely lack problem framing, modelling and statistical skills. There is a lot of data floating around on how smart cities and big data technologies in general can transform the economy or at least deliver a boom in jobs related to data science. (see Tejaswi, 2012) The latter 'boom', I would argue, is a generative site for re-imagining expertise.

'You are a researcher, so you must know some use cases right?' This question is frequently posed to me in data science meetups. [5] By now I have rehearsed a few answers to keep the conversations alive. However, the problem here is not just a lack of use cases for techies to apply their data science skills. The data science communities in Indian cities like Delhi (including Gurgaon), Bangalore and Hyderabad which have major IT industries, are growing steadily. Yet there is little knowledge being produced on how to frame data problems in sectors other than the traditionally data savvy ones like business analytics, online marketing or supply chain management. The India chapter lead of a global data science community, which strives to solve data problems in the social sector on a pro bono basis, recently told me that there is very little interdisciplinary understanding of what data analytics can do in the social sector both among engineers as well as the people running NGOs.

This leads us to the question: who essentially is an expert on smart cities? Or rather, who is imagined to be an expert? This will (and should) remain an open question. Nonetheless, the techno-managerial domination of expertise on smart cities is quite apparent. [6] The consultant I interviewed argued – in defence of his perspective on the insignificance of space for ICTs and sensors – that 'water, electricity, health and education are all governance issues which we cannot solve. It's the government's job. We are here to provide expert solutions for collecting and analysing data'. While technological determinism and profit-driven approaches are historically characteristic features of such consultancy brand of expertise, this *peculiar division and thus reconfiguration of knowledge domains – of data analytics and governance – is a new, contextual occurrence*. Finding ethnographic nuances of these imaginaries remains a work in progress, though Delhi's own history of urban planning provides a crucial stepping stone. As Sundaram observes:

> The Masterplan's landuse and zoning maps did not simply organize space into rational, manageable units for the new rulers. That had been done since the colonial era. As a specialist instrument of knowledge, the planning map of the 1950s fabricated urban expertise in Delhi. Planners and consultants now claimed privileged access to technical knowledge of the city, and consequently to political power. (Sundaram, 2009: 65)

Later in the book he continues:

> In the planning era, information helped to produce the city as a visible, rational entity within a hierarchy of parts. This was done for the public, but particularly for the postcolonial elites who were able to access the city using the authorized language of planning. All this changed with the simultaneous decline of planning and the emergence of globalization and technological networks in the city. (Sundaram, 2009: 175)

Perhaps what we are witnessing now are remediated attempts to make the city 'visible' or knowable through data analytics. However, this is happening in a new zone of expertise and knowledge production. This emerging zone, wherein data analytics is imagined to be *the* site and *the* method of knowledge production, marks an important departure from the episteme of decentralisation that has dominated the discourse on network societies and urbanism in the last two decades. (Graham and Marvin, 2001) This departure is further complicated by erratic boundaries of relevance of data analytics in urban governance. Thus, the emerging nature of expertise and knowledge production are key for understanding the socio-technical imaginaries of data-driven urbanism.

Emergence iii. 'What do we want?' 'open data!' 'when do we want it?' 'now!' – 'wait, who is "we"?'

A recent meetup of an Open Data advocacy group was organised to discuss the issue of opening water data in Delhi. [7] This meeting was attended by over forty people from diverse backgrounds including software engineers, urban researchers, non-profit workers, activists and politicians including the minister in charge of water in Delhi. The meeting, which lasted for more than four hours, saw lively discussions on several micro and macro issues of water infrastructure in Delhi such as the governance structure of water management bodies, existing data on water and its authenticity, disparate supply in adjacent areas, illegal supplies and so on. Towards the end of the meeting the core members requested everyone address the main objective of the meeting which was: to frame data problems associated with water in Delhi and devise strategies for opening up water data.

The conversations between different stakeholders and the confluence of different standpoints and perceptions of both water and Delhi at this meeting made it a rare event. Debates on several ideas, like making the best use of the current data, which does not include much of end user data, as opposed to geo-tagging water data (by collating spatial data sets with existing water data) and installing new sensors and smart meters, kept resurfacing. The narrative went back and forth on issues of access to water for the end users and systemic accountability – and the role of data animated all the proposed solutions. Interestingly, people who were not acquainted with Open Data and analytics also chipped in. For example, an agent who acts as an intermediary between people of his residential area and the governing body for water in Delhi, suggested that we should focus first on data from resettlement and unauthorised colonies as the

governing body always gives them the least priority.

I observed similar but slightly more formal discussions at a couple of events organised by the central government's Open Government Data (OGD) initiative, which is one of the leading OGD initiatives in the world, in Delhi. [8] A selectively condensed narrative on Open Data was also evident in a few hackathons – which were meant to crack governance and civic problems by creating web and mobile applications utilising open government datasets.

Lilly Irani in her ethnographic study of hackathons in Delhi remarks that, 'hackathons *sometimes* produce technologies, and they always, however, produce subjects'. (2015: 2) Hackathons have a pre-decided agenda and only attract a select set of people, mostly from privileged backgrounds, for whom the event is a rehearsal of what Irani refers to as 'entrepreneurial citizenship'. While hackathons and Open Data meetups have a fairly different structure, the two categories of events, as I have come to observe, have a lot in common.

Open Data meetups do not involve programming and product development, and thus the discussions and debates there are much wider. However, the idea of data-driven problem solving for social good animates the agenda of both the events. Also, from what I have observed, the set of people who attend civic hackathons are actually an approximate subset of people who are involved with Open Data meetups and advocacy. This I think sets the stage for a broader reconfiguration of citizenship, which is not limited to entrepreneurial character.

At one level, the Open Data, and especially OGD movement can be seen as an evolution of public participation in a democracy. However, this form of participation reconstitutes the public and tacitly opens a register for classifying their civic affinities based on their engagement in the movement. When a group of data savvy citizens transparently partner with the government to open water data to solve water problems for the entire city, or when a group of engineers build an Android application for water grievance redress, they are not just participating in a democratic process in a fixed sense of the term. (Kelty, 2017) Rather, they are creating new, technologically mediated and/or affected meanings of democratic citizenship.

This may seem to be an obvious point in the Indian context where the Right to Information Act (RTI) and anti-corruption movements are still fresh in memory. However, the Open Data movement's genealogy lies much more in the open source software and open access movements than the RTI. (Kitchin, 2014a) And unlike RTI, Open Data comes with specific technological formats (with machine readability) and licenses. OGD offers distinctly new affordances to citizens to engage with the government and unsettles old ideas of civic liberalism. The imaginaries of Open Data though are not related to smart cities per se. Through the emergence of *government data as a civic commodity* and *select citizens as civic data scientists*, Open Data imaginaries have contingently become a part of the emerging urban data ecosystem, which otherwise is dominated by market driven imaginaries.

Emergence iv. Apps – microcosmic smart cities

'We are looking at a very specific problem for providing smarter insights to our customers. We are not in a position to take a systems level problem solving approach.' This was a perfectly rational response by the lead data scientist of a popular housing application to my question on how they frame their data problems given the complexities like informal modes of governance, unauthorised colonies and slums. Application of

this algorithmic episteme of dividing the problem into smaller chunks to cities – though driven by business models – creates an interesting problematic for systems thinking. One wonders how the access to city's real estate will change for this application's users vis-à-vis its non-users. Will emergences of this application in the broader city system be amoebic or rhizomatic? I do not know the answer, but I have a few reflections to share on the world of urban utility apps which exemplify this problematic.

With the decline in prices of smartphones there has been a phenomenal rise of apps that offer solutions and services to suit the needs of everyday urban life. The ecosystem in which most of these app-developing companies and start-ups operate is rich with data collected from all user online activities and especially social media. This has also added to the premium placed on data-driven solutions in the start-up ecosystem. To stay within the scope of this paper, I will only discuss some urban utility apps that are at the cutting edge of remediating users' interaction with urban infrastructures and services.

In a recent blog post, Housing.com, one of the unicorn startups in India, explained their data model as follows:

> Imagine this – Mr. X wants to move. He visits Housing.com and selects the city and neighbourhood where he'd like to live. Like an efficient personal assistant, we understand his requirements, social network, and community. We use this personalised understanding to recommend houses. He explores his top choices virtually, selecting furnishings that suit his tastes. Maybe someday he can go outside and look around, all in virtual reality. Once he has decided, we instantly connect him to the bank. The bank checks his credit history and approves the loan. The sale is done. He schedules a move-in date and we send movers to shift his belongings from his old house to his new home. This is the experience we want to build in the future. *Each of these steps is connected to the next with a huge amount of data about the customer, real estate, credit histories, loan criteria, and much more*. *Data science will be the key differentiator for all platforms providing real estate services, or really, for any services-based industry*. (Housing.com, 2015; my emphasis)

The network of service providers and data sources this app is mobilising to better understand its users, and help them make informed choices, is creating an immense number of unparalleled and largely opaque feedback loops between the users, platforms and databases.

There are many similar examples. Zomato, for instance, claims to have created a database of every dish served in restaurants in over 10,000 cities, through which it provides recommendations and user-generated reviews and ratings. Another app, Ridlr, which was launched earlier this year, utilises public transport and spatial data to provide timetables and user location sensitive transport information, recommendations and updates in all metro cities of India. Both these apps, along with several others, claim that their aim is to enable users to make 'informed choices' for better services. Clearly they are quite modest about their effects and affects.

The feedback loops on which they operate remediate if not entirely redefine the choices users can make – in varying degrees across different sectors. In fact, unlike urban planning which has a long history with data-driven practices, these apps are emerging in a context in which areas like housing, food or transport have never explicitly been looked at from a computational and/or analytics perspective. The *personalised* insights mined from deeply mashed-up datasets, which these apps promise, puts them on the same plane

of imagination as smart cities. Except of course the difference of scales, which brings us to the key question: from a systems theory perspective, what does the sum of these apps mean for the city? In other words, what will be the nature of interaction between these microcosmic smart city-like parts and the city as a whole? Will these interactions allow us to finally abandon what David Wellbery refers to as the 'intellectual comedy of cultural analyses that find a bit of social determinism here and a bit of individual agency there or link the two in some sort of circular causality'(in Mitchell and Hansen, 2010: 305). Perhaps the non-systemic or systems agnostic imaginaries which these apps embody – too complex to be grasped by political or value judgements – as an emergence would allow us to make an 'informed choice' of thought while studying sociotechnical systems like data-driven cities.

Emergence v. Political analytics

The 2014 general election in India will be known for its many firsts. Among other things, it was the first time data analytics became a substantive part of an election campaign in India. Drawing a leaf from Barack Obama's campaign – which is considered one of the best examples on big data's capabilities, Prime Minister Narendra Modi had a data analytics team monitor his party's social media campaigns and voter engagements. While there is little evidence to believe that data analytics had an impact in terms of votes, it did transform the online political discourse. A news article quotes a source who describes how Bharatiya Janata Party's (BJP) targeted voters online:

> If you move out of the BJP website and visit a website for bikes followed by a search on jobs, the algorithm will make the inference that you are a young male from a particular constituency, say Delhi, who is currently on a job hunt. What happens next is when you visit a job searching portal like Naukri.com, this system pops up a contextual ad for you like 'jobs in Delhi'. The BJP banner which is just below the results will tell you 'There are no Jobs in Delhi. India deserves better'. (in Shah, 2015)

Interestingly, this is the exact same process – called programmatic marketing – used for automated digital marketing of brands. By tracking users' online movement through cookies, digital marketers are able to algorithmically re-target users with ads of products they may have viewed or are likely to buy. In case of elections, given the size of the Indian electorate, it is much easier to profile voters as compared to consumers for marketing campaigns of specific brands.

Apart from this, data analytics is used in election campaigns and otherwise by political parties to monitor and optimise their party's and its leader's social media presence. Here, too, the tools are the same as digital marketing of brands.

Similar strategies were adopted by the Aam Admi Party (AAP) for the Delhi assembly elections. Their model was guerrilla-like in comparison to BJP's organised data analytics teams. Still, AAP managed to take data analytics in election campaigns a step closer to digital marketing of brands. They ran sentiment analysis of Twitter to gauge the public opinion on social media which fed back into their manifesto and campaign. (Dadawalal, 2015) [9]

In an interview, a core member of the AAP's social media team told me that during the campaigns they constantly monitored all media sources to stay in touch with the latest news and events. They created the party's responses to news which concerned them and broadcast it using multiple WhatsApp groups, Twitter

and Facebook. Additionally, they created weekly reports of social media analytics by studying their Facebook and Twitter analytics (using a third party software, since Twitter had not launched its own analytics dashboard until then). The reports included suggestions on timings, language and composition of social media posts, topic-wise traction details and even sartorial suggestions for s, video and television appearances. Another AAP member who headed the sentiment analysis team told me that since there are not many good, free sentiment analysis tools available so, they coded one for themselves. They used textual sentiment analysis of tweets related to the Delhi elections to get a sense of public opinion on important issues and relayed it to the party.

All three of these data analytics methods – programmatic marketing, social media web analytics and sentiment analysis – which have been imported from digital marketing into political communication, mark an unprecedented convergence in marketing and politics. This *blurring of boundaries between citizen, user, consumer and voter is constitutive of the new political*. While it is common knowledge that network topologies of social media have engendered new forms of the political, the materiality and poetics of this cultural-infrastructural transformation are yet to be seriously examined. (Gillespie, 2012) The data-driven imaginaries of the new political (and vice versa), which seem to materialise through the perpetually multiplying feedback loops between the users' data shadows, platforms and data analysts/scientists, are underpinned by the largely opaque architectures of social media platforms. Given the great Indian rural-urban divide in Internet access, this new political imaginary of data (and data imaginary of politics) is invariably an urban phenomenon. The computational work that creates the infrastructural conditions for blurring the aforementioned boundaries, belongs to the same category as the work which is being undertaken – or is being imagined to be undertaken – for making our cities data-driven or smarter.

Conclusion – a prelude to meta-analytics of data

In this paper, I have attempted to reflect upon the sociotechnical imaginaries that are constitutive of smart cities in the Indian context. Expanding upon the data-driven character of smart cities I have tried to highlight their conceptual and material connections with the debates on big data and the data revolution. Given the longer histories of postcolonial urbanism and the non-digital, infrastructural conditions of Indian cities, I have tried to contextualise the contemporary moment so as to have something to hold onto in what seems like a socio-technical vortex called smart cities. Drawing upon my ethnographic experiences in the last six months in Delhi, I have briefly discussed five interconnected, non-exhaustive emergences of data-driven urbanism to highlight the possibilities of grounded inquiries. Given the lack of any precedence for such an inquiry and the formative nature of these emergences, I have avoided any premature criticism or appraisal of data-driven systems. Rather, my attempt has been to open up questions, concerns and ambiguities about the new zone of techno-urban flux we find ourselves in.

My central argument (if any) is that emerging modes of data-driven knowledge production are reconfiguring ways of knowing, experiencing and governing a city. The diverse field sites and actors introduced through the ethnographic material, portray some of the on-going reconfigurations which are getting materialised differently in different sites. Given the infancy of these emergences, there has been no explicit attempt to draw connections between the five ethnographic vignettes – namely, the new image of the city, the changing nature of expertise, civic data activism, apps as microcosmic smart cities, and political communication and analytics. However, if one has to look for a pattern, it perhaps lies in the implications and questions that these emergences provoke.

When the lines between mostly settled categories like citizen, user, consumer, voter or perhaps data-miner/analyst, and government, consultant, infrastructure regulator, platform or app designer or database administrator, begin to get blurred in multiple registers of socio-technical imaginaries and their materialisations, the pattern of concerns perhaps then should be aligned for a rethinking of the conceptual basis of these categories. To that end, we need a much deeper understanding of the vignettes discussed in this paper through longer ethnographies that can produce thicker descriptions of data-driven urbanism in the Indian context.

While being an exploratory ethnography of sorts, this paper can also be read as an experiment on the suitability of the ethnographic method in studying contemporary emergences like big data and smart cities. Though ethnography has been widely appropriated in STS and media studies, it requires another level of reflexive recalibration to allow richer engagements with the generative potentials and materiality of digital technologies and infrastructures. Especially in a postcolonial and global south context like India where technologies and infrastructures materialise very different kinds of sociality and vice versa – than the ones which dominate the technology studies discourse – a conversation on socio-technical imaginaries is highly improbable without substantial emic insights. The methodological recalibration required for engaging with nuances of data-driven systems can perhaps be initiated with a change in epistemological stance. As Nick Seaver perceptively notes:

> Rather than expending our efforts defending thickness, attacking formalism, or regulating the connections between the two, we might investigate these systems of relating themselves. To put an anthropological spin on it, we could study the kinship of method: How are methodological relationships deemed legitimate or illegitimate? What has the rise of 'big data' as a discursive and technical phenomenon meant for the ways methods relate? How do various groups of people – data scientists, ethnographers, managers, advertisers, 'users' – themselves partially constituted through these relations, imagine them to work? To talk about the kinship of knowledge, we'll want to draw on our knowledge of kinship. (2015: 6)

It is this two-way traffic between knowledge and kinship systems, and data and its socio-technical relationalities, I will conclude, that calls for us to seek a meta-analytics of data; to help frame the conceptual and material ontologies of data analytics without reducing its known and unknown life-worlds – which now includes cities – to either that of pure objects or culturally constructed networks. To that end, perhaps we should let the data speak for themselves, albeit holistically, and develop techniques to listen and comprehend its material and cultural conditions.

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Notes

[1] To know more about the government's Smart Cities policy, see Rakesh (2015).

[2] Big data is generally referred to as massive, dynamic, machine readable datasets which cannot be stored or analysed using the relational database technologies (RDBMS). Big data departs from standard ways of data analytics not only by an increase in the size of data, but big data is also characterised by the speed and diverse nature of data. This requires a new set of approaches – architectures, algorithms and tools.

[3] Almost all the cities selected under the Smart Cities program are 'brownfield' cities, that is, existing cities, which will be elevated to smart cities through redevelopment and retrofitting.

[4] 'Layers are the mechanism used to display geographic datasets in ArcMap, ArcGlobe, and ArcScene. Each layer references a dataset and specifies how that dataset is portrayed using symbols and text labels. When you add a layer to a map, you specify its dataset and set its map symbols and labeling properties.' See ArcGIS Resources: http://resources.arcgis.com/en/help/main/10.1/index.html#//00s500000006000000

[5] 'In software and systems engineering, a use case is a list of action or event steps, typically defining the interactions between a role (known in the Unified Modeling Language as an 'actor') and a system, to achieve a goal.' See https://en.wikipedia.org/wiki/Use_case

[6] Recently the government had to withdraw a tender after it was found that one of the bidding companies' employee was the author of the tender document (Aurora, 2015).

[7] Broadly the Open Data movement is aimed at making datasets, which are generated using public funds and are not entangled with matters of privacy and security, freely available for everyone to access and use without restrictions of copyright, patents, etc.

[8] India was one of the first few countries to create an Open Government Data Platform, https://data.gov.in/. To know more about the Open Data ecosystem in India please see Sumandro Chattapadhyay's (2015) research project report on Opening Government Data in India.

[9] As the name suggests, sentiment analysis involves application of computational methods (like machine learning, natural language processing, computational linguistics, etc.) for mining subjective information from texts, images or videos.

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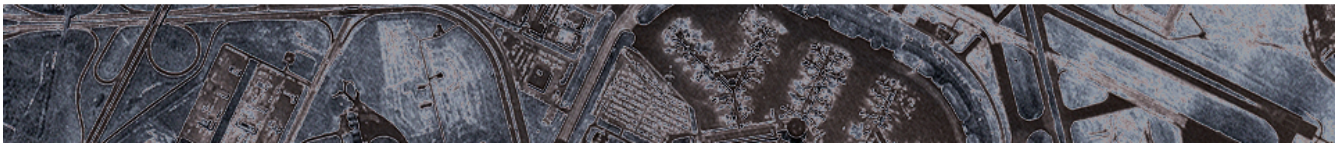

FCJ-218 Train Ticket Sharing: Alternative Forms of Computing in the City

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Abstract: Who exactly defines the internal flows of the city, and what happens when this 'flow' is rendered bottom-up? Rather than exploring the ways in which the digital affects the organisation of the city, in this paper, I aim to show how certain smart systems of coordination – based on a non-digital 'smartness' – exist in parallel to the increasingly digital smart city today. Various forms of improvised coordination and human-led calculation are an integral part of the smartness of a city and must not be overlooked. Drawing on ethnography of train ticket sharing networks in Germany, this paper explores the assemblages of human and non-human, digital and analogue actors that can attach themselves to an existent system, acting as 'parasitic infrastructure'. Understanding how these parasitic infrastructures emerge highlights how systems of calculation and computation exist beyond just the digital.

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Introduction

In the city of Grodno, Belarus, which is populated by around 300,000 inhabitants, the main form of transportation is the bus. This transit system is run by a public company called Grodno Bus Park. In 2008, the bus company cancelled their reduced-price tickets for students and seniors, and all passengers were expected to pay the same price for a ticket. While each ticket cost only 0.15 Euro (1700 Belarusian rubbles), this was enough for somebody on a 200 Euro monthly salary to get agitated. In order to challenge the change in ticket price, public bus system commuters started ticket sharing. A bus passenger would leave the bus at their destination and hand their used ticket to a boarding passenger, free of charge. As Grodno Bus Park tickets had to only be 'punched' by the ticket machine located inside the bus in order to be deemed valid, and had no time or bus number printed on them, bus drivers or ticket controllers were not able to prevent travellers from re-using these tickets over and over again. Strangers would often leave their unwanted (yet still valid) bus tickets on seats, or hand them over again to people standing at the bus stop as they left their bus. In 2013, Grodno Bus Park, [1] started an advertising campaign to help prevent this type of ticket sharing from taking place. Flat-screen televisions in every bus started periodically showing an advertisement featuring 'Do Not Share' boldly pointing at the ticket sharing scheme. These screens became

a symbol of a spontaneous system of coordination between citizens being confronted with the power of the state.

Similar ticket sharing occurs in various cities in various forms. Grodno's bus ticket exchange is an example of a non-monetised ticket sharing system, where passengers literally give away their tickets to others. A similar system is also popular in the Polish city of Poznan, where travellers leave their tickets on the bus seats for the next passenger to use. In certain cities in Pakistan, bus tickets are re-sold by illegal ticket vendors who buy and resell used tickets, in a sort of second-hand market. In Germany, monetised ticket sharing is becoming more common during train travel. With train tickets being less affordable, people are increasingly grouping together using online (for example, Mitfahrgelegenheit.de) and offline (for example, Hauptbahnhof) spaces in order to coordinate travel using group or family tickets, saving sometimes 70% off the regular ticket price. These examples, as well as the story of the Grodno Bus Park – aim to foreshadow certain spatial, temporal, and material aspects of computing in the city that will be explored in this paper. Searching out others to share a ticket with, as well as traveling with a group of strangers, requires a 'smart' system of coordination and calculation – creating a sort of social, material and technical infrastructure.

The origins of the smart city in the 1990s brought visions of an environment of constant management and control – connecting the 'physical infrastructure, the IT infrastructure, the social infrastructure, and the business infrastructure, to leverage the collective intelligence of a city' (Harrison et al., 2010: 2). Yet even earlier, the practice of 'computing the city' can be traced back to the vision of coordinating mobilities. The early days of smart, computable logistics were about coordinating and computing flight and train schedules, monitoring car traffic, or calculating the prices of tickets. The act of computing the city began, historically in the 1950s with the US-government-led SAGE (Semi Automatic Ground Environment) project, which developed a centralised command-and-control system whose structure mirrored the command structure of the United States' Air Force which funded it. Yet commercial real-time computing systems began with airline reservation software (Campbell-Kelly, 2003: viii). The first and classic civilian real-time project was the SABRE airline reservation system. Born in 1964 through a venture with IBM and American Airlines, it was a path-breaking application that gave American Airlines a great commercial advantage over competitors (Campbell-Kelly, 2003: 1). Soon after, other ticket reservation systems, bank automation, and retail systems also followed suit. These leading-edge applications required one or more mainframe computers, novel terminal devices, and telecommunications equipment, all of which had to be integrated by means of software (Campbell-Kelly, 2003: 41). The software that once calculated and coordinated airline reservations, ticketing, check-in, and management reporting is not so far off from the current DeutscheBahn (German Rail) system used to calculate and coordinate train mobilities.

Yet rather than exploring the ways in which the digital affects the organisation of the city, in this paper I aim to show how certain smart systems of computation and coordination – based on non-digital 'smartness' – exist in parallel to the increasingly digital smart city today. In any city, coordination and communication methods were not, and currently are still not, only developed through ubiquitous computing and smart sensor networks. Various forms of improvised coordination and human-led calculation, which make use of public infrastructure to create new forms of infrastructure, are also an integral part of the smartness of a city. In order to explore this 'smartness', I will introduce the improvised, dynamic, ad-hoc socio-technical infrastructure of ticket sharing. To help analyse these smart systems, I will draw from my own fieldwork of train ticket sharing, where I also used Erving Goffman's explanation of orientation and coordination among strangers. To explain how this practice of ticket sharing relates to the general train infrastructure in a city, I

introduce the notion of 'parasitic infrastructure'.

A parasitic infrastructure, much like the name suggest, functions as its own being, but needs the 'host' infrastructure to function. Much like the Grodno bus ticket, or the DeutscheBahn ticket sharing network, it is created as a result of an ad-hoc, improvised coordination and cooperation of various actors. A parasitic infrastructure attempts to operate without the detection of the host infrastructure, yet it's detection effects the actions of the host infrastructure, which adjusts its behaviour to repel the parasitic infrastructure. I will argue that this constant relationship between the host infrastructure and the parasite is necessary to keep a city 'smart': more efficient, more malleable, more in-tune with the various stakeholders living in a city. In order to paint a picture of another form of smart city, I will ethnographically outline one such parasitic infrastructure: a train ticket sharing system that exists in parallel to the large technical infrastructure of the German rail system. This parasitic infrastructure is ad-hoc, analogue, and encroaches on various legalities. Yet this system holds characteristics much like those prescribed to digital smart cities: an intelligent web of protocols, constantly updating itself based on its surroundings, a mixture of data (information), things, and people.

Introduction to Ticket Sharing

Ticket sharing is an informal, yet culturally recognised form of travel for most Germans who use the railway system as a method of transport. Train ticket sharing functions in a number of ways, depending on the time and day of travel, the number of people traveling, and the given route. Rail transport in Germany (DeutscheBahn) is one of the largest in the world, carries nearly two billion passengers per year, and is administratively divided into a national, regional (provincial) and city train system. Train travel is very costly, with regular travel between larger cities costing between 50 and 100 Euros. Yet in order to avoid the large expense of travel, the DeutscheBahn's various national, regional and city routes offer 'deals' on train travel, with the most popular being the weekend Schönes Wochenende ticket. This ticket allows five people to travel nationally, using only regional trains, on Saturdays or Sundays. For example, train travel between Hamburg and Frankfurt using regional trains on any given Saturday costs 70 Euros one way for one person. Grouping together with four other people using a weekend ticket will bring the ticket price for one person down to 8.40 Euros. Another popular discount often used by train ticket sharers is the regional ticket. This ticket allows five people unlimited 24-hour travel within one given state of Germany, and can be used any day of the week. A commuter traveling one hour between Hamburg and Kiel, for example, would normally pay 21.20 Euros for their journey. A five-person group ticket, costing 33.30 Euros, brings the price of one person's journey down to 6.66 Euros. While DeutscheBahn designed the group tickets for families and friends (for example, one of their earlier advertising slogans was: 'take your children or grandchildren along for a weekend trip'), the ticket sharing system has been adopted by groups of friends, colleagues, or strangers. The access to such a drastic discount in ticket price, or the opportunity to save money, has shown that actors using this infrastructure will shift and readjust the given infrastructure in order to transform it into something that suits their own needs.

In recent years, since the proliferation of smartphones, strangers have begun to seek out other strangers to travel with mainly by coordinating online, through ride-sharing websites like Mitfahrgelegenheit.de or Mitfahrzentrale.net. Here, one person advertises a journey (e.g., Hamburg to Frankfurt), on a given day (e.g., Saturday) at a given time (e.g., 13:00hrs), and indicates how many places they have available on their 'ticket'. Subsequently, the ticket holder coordinates their ticket sharers – asking them to meet at a certain

time before the train departure. The meeting point is negotiated, although repeated practice of ticket sharing helps develop distinct 'meeting spots' at a train station, and this meeting spot varies from station to station. When searching for ticket sharers at a train station – strangers search out other strangers in order to share their ticket. This process involves a coordinated, networked entrepreneurialism that uses digital technologies in order to 'leech' onto an existent infrastructure and compute and coordinate a transport system. But how does such leeching emerge?

The Infrastructure, The Parasite, The City

This work-around ticket sharing networks first started by asking, 'What does it mean to consider the city as a place that is not just inhabited but which is produced through that inhabiting?' (McFarlane, 2011: 3). The city is an urban assemblage, which 'makes possible a double emphasis: on the material, actual and assembled, but also on the emergent, the processual and the multiple' (Farias, 2010: 152). Yet, as some noted, 'while systems in industrial cities were mostly skeleton and skin', post-industrial cities, or smart cities, are much like 'organisms that develop an artificial nervous system, which enables them to behave in intelligently coordinated ways' (Chourabi et al., 2012: 2290). This skeleton, skin and nervous system can also be conceived as an infrastructure of a city. Infrastructure is a powerful phenomenon, shifting organisational routine, practice, and capacity.

Imagining the smart city as a multitude of overlapping infrastructures is useful to our analysis here as it can help us understanding the standards that help systems scale up, as well as the equally significant issue of how systems scale down, that is, making global infrastructures locally useful (Edwards et al., 2009; van Laak, 2004). Edwards et al. showed how infrastructure studies offer different lenses on phenomena fundamental to everyday life in contemporary societies (Edwards et al., 2009). Susan Leigh Star (1999) used the term infrastructure as an analytical concept in order to describe something that is neither simply technology, nor simply organisation nor simply institution. Using the theoretical approach of infrastructure studies can help to understand the point where humans and structures meet – making the moments of formation (Edwards et al., 2009) of infrastructure exciting. Larkin highlights the importance of '[redirecting] analysis upstream, away from the social effects of infrastructure and toward practices of conceptualisation that come before the construction of the systems themselves and which are engineered into them' (Larkin, 2013: 332).

But what if we return to McFarlane, and envision an alternative infrastructure that is produced through inhabiting, produced through a re-assemblage of the current system? What of the systems that make use of other systems? Within any meaningful account of how smart cities develop – issues of frailty, issues of failure, everyday embodied practices; all must be taken into account. Humans and structures do meet, infrastructure is customised, and a non-digital smart city exists and unfolds on many dimensions. I aim to explore these issues using the concept of infrastructure and more specifically, looking at how 'parasitic infrastructures' unfold. This analysis of these overlapping infrastructures also aims to show how sociality emerges, how cooperation works, and how power emerges within smart cities.

I use the concept of the parasite as a metaphor for the way in which socio-material systems function, in particular when one system works not in parallel, but rather exploits another, in order for it to function. Much like parasitic computing, parasitic infrastructure occurs when an urban infrastructure such as a train transport system serves unwittingly as the basis for other transport networks. The term 'parasitic

computing' was first introduced in August 2001, when Barabási et al. (2001) found a way to solve mathematical problems using external computational power without knowledge or permission of their respective owners. In their paper, they explained a parasitic computer 'attempts to solve a complex task by breaking it up into many small components and distributing the processing related to those components over a number of separate remote computers' (Barabási et al., 2001: 3). On another level, the parasite could be understood as a being that which not only uses the infrastructural power of the host, but also affects the actions of the host. In Serres' understanding, the parasite redirects reproduction: it steers it in a new direction favourable to it. The parasite adopts a functional role: 'the host survives the parasite's abuses of him – he even survives in the literal sense of the word; his life finds a reinforced equilibrium, like a sur-equilibrium' (Serres, 1982: 168). It is precisely this 'sur-equilibrium' that is necessary for smart cities to function, and this parasite infrastructure/host infrastructure relationship fuels the development of a city forward. As shall be discussed in this paper, forces that shift, develop, and re-configure cities can be understood through the relationship of the urban infrastructure and their parasites that affect their development.

The research for this paper is based on ethnography of the train ticket sharing practices in Germany, and was initiated by Alexa Färber at the HafenCity Univerity in Hamburg, as part of the Low Budget Urbanity Research Group. Alexa Färber's initiated fieldwork among ticket sharing networks in Berlin and Hamburg (Färber, 2014), my phase of fieldwork was conducted between November 2012 and June 2013. The work was multi-sited and engaged in a range of semi-structured interviews and participant observation. By engaging in multi-sited ethnography (Marcus, 1995), 'the relevant boundaries to the analysis are not fixed a priori, they are "discovered" on the ground' (Candea, 2007: 177). During this time, I 'hung around' Hamburg Hauptbahnhof, tracking travellers and patterns of behaviour of ticket sharers. I travelled with ticket sharers from Hamburg to Kiel and Lübeck between the same periods, as well as between Hamburg and Berlin and Hamburg and Leipzig. The so-called 'second generation of multi-sited ethnographers' prefer to talk about 'cross-fertilisation of sites' (Gallo, 2009: 89) to move away from holistic aspirations that could have been observed in the first stage of development of that multi-sited concept. I worked with reflexive qualitative interviews (Alvesson, 2003), a method often accompanying observation (Darlington and Scott, 2003). In-depth interviews were also conducted with 20 travellers, ticket sharers, as well as two expert interviews with representatives from German rail (DeutscheBahn). These interviews were conducted in German, and were loosely structured (Whyte, 1984).

The Emergence of a Parasite

Searching for ticket sharers involves a 'multiplicity of processes of becoming, sociotechnical networking, and heterogeneous collectivity… the alignment of different elements' (McFarlane, 2011: 5). The coordination and 'intelligence' of the train ticket sharing system relies on a variety of collaborating elements, which make up socio-material infrastructures (although their conscious collaboration is not necessary):

- The intelligent transport system (train schedule system)
- The ticket machine
- The train ticket

- The DeutscheBahn app
- Train station (platforms, hallways, etc.)
- Online ridesharing websites (Mitfahrgelegenheit.de)
- Ticket regulations/DeutscheBahn (etc.)

Although this list is not exhaustive, it outlines the variety of non-human actors – which belong to the host infrastructure – and which set the stage for the parasitic ticket sharing practice. Identifying these elements of the host that enables this new practice is crucial, because it can outline the way in which the parasite 'customises' the host's built environment to fit its needs. In the case of ticket sharing, the relationship between the physical setting and the way practices and infrastructures are formed and transformed is a crucial part of the process of customising infrastructure. During fieldwork, I noted:

> I arrive to the Hamburg Hauptbahnhof (mainstation) at rush hour. It's 16:38 on Tuesday, the 6th of November and I try to search out departure times for regional trains – these are the trains that offer the five-person, group ticket discounts. Trains going to Kiel and Lübeck seem to be leaving around every 15 minutes. I walk around the building, searching around for ticket machines. My colleague mentioned that people searching for ticket sharers tend to place themselves near ticket machines. (field notes, November 2012).

The complex character of the train station as an 'immobile platform' represents the 'multiple fixities or moorings often on a substantial physical scale that enable the fluidities of liquid modernity, and especially of capital' (Hannam et al., 2006: 3). The train station, much like the airport or bus station, is a key platform of coordination and cooperation between intimates and strangers – and the way in which people collaborate and cooperate is done parasitically – using the physical setting as a breeding ground for their own practices. As Serres noted, there is 'no house, ship or palace that does not have its share. There is no system without parasites' (Serres, 1982: 12). The Hauptbahnhof is a host for a variety of parasitic practices.

An interview with a frequent commuter in Leipzig revealed that the Hauptbahnhof is not just a structure of platforms and waiting areas, but that within this practice, the space comes to acquire certain hot spots – places that acquire meaning because of their importance in the ticket sharing exchange. This is the first example in which a built infrastructure becomes a host, onto which the parasite attaches itself and develops. Hot spots such as meeting points become an invisible yet highly important place of coordination. These certain key spaces of coordination in a main station actually materialise in the consciousness of each commuter, and are invisible to those in constant flux or mobility. Those who want to search out a commuter will return to certain meaningful spaces in order to find other ticket sharers or other commuters. For example, the commuter in Leipzig described the certain areas around the station which acquired significance for ride-sharing:

> … in Leipzig there is one big spot for Mitfahrgelegenheit.de users at the east side of the Hauptbahnhof. It's actually a parking lot for travelling buses and so actually it's not allowed to park on this parking lot but there are – I would say from Friday to Monday or Sunday mostly like 20 cars at the same time and exchanging from nine to eight in the evening… (30 year old male respondent, Leipzig)

In another instance, I spoke to a ticket 'manager' – meaning the entrepreneurial figure who rides the trains back and forth on a popular train commute (for example, Hamburg to Kiel), and re-sells the four places on his five-person train ticket. This particular 'manager' I spoke to started explaining how he finds people to buy a place on his ticket:

> P: How do people find each other?
>
> V: You want to see it now?
>
> P: Yeah…
>
> V: How we find others?
>
> P: Okay. Yeah.
>
> V: Those (points) here there, there yeah, yeah easy ways.
>
> P: Easy ways?
>
> V: When someone goes by you, you just go over to them… ask and talk…
>
> P: Ah. So near the ticket machine is better as a place?
>
> V: Right at the ticket machine. (50 year old ticket male ticket 'manager', Hamburg)

The location of ticket sharing flows such as stopping and going is not arbitrary, and certain places in the main station gather meaning as the practice of ticket sharing unfolds. The Hauptbahnhof is thus customised by a collective (in this case, by ticket sharers), in order to accommodate their practice. Here, the intention of an infrastructure – that it provides a platform for travellers buying tickets, transporting luggage, or greeting friends and family – gains a new purpose as the parasite makes the infrastructure its home. At the Hauptbahnhof, an area intended for family members to wait for the arrival of their loved ones, becomes hijacked and customised to fit the needs of train ticket re-sellers or 'managers'. In Leipzig, users of the ride-sharing and ticket sharing website Mitfahrgelegenheit.de use a certain parking lot to meet. While this re-configuration of a space might not be a desired practice for the DeutscheBahn who helped build and maintain the space, for those fostering a parasitic practice, this flexibility and lack of regulation over a given space helps their practice grow.

At the moment of my own fieldwork, ticket sharing became a contested practice, and security officers at various train stations began to monitor 'suspicious' activity. Only when the parasite becomes noticeable can it be eliminated. Serres (1982) notes that the parasite at times makes noise, which, once noticed by the host, puts the parasite in danger of being discovered and thus eliminated. In this instance, security officers are employed in order to eliminate the parasite – and chase away any activity that contests the original purpose of the train platform, and the ticket 'managers' who offer alternative forms of ticketing to the existent train infrastructure. But this 'noise, through its presence and absence, the intermittence of the signal, produces the new system, that is to say, oscillation' (Serres, 1982: 52). Power over a space is

constantly being shifted from the host infrastructure to the parasite who customises it to fit its needs.

The Body of the Parasite

'Many of the spaces of the urban built form are engineered to facilitate these practices of waiting particularly in relation to journeying and travel … shelters, benches, platforms, waiting rooms, and traffic lights' (Bissell, 2007: 282). The ticket sharer is constantly jumping between action and inaction – between waiting and acting. Those who yet have no ticket are waiting at the whim of another to offer them a space on their ticket. There are moments where the ticket sharer just stands or paces back and forth around the ticket machine, with his/her ticket in hand, waiting for a traveller to approach them. And vice versa, there are moments where the traveller is passive, just waiting by the ticket machine in hopes that a ticket sharer will approach them. Both the ticket sharer and the ticket traveller do their share – with their bodies, through their gestures and movement – in creating the parasite. Thus, 'the body itself is of course engaged in and enacting a whole kaleidoscope of different everyday practices and forms during the course of this waiting' (Bissell, 2007: 282).

I would argue, then, that the parasite's body must improvise, calculate and be flexible – to do what is not prescribed by the host infrastructure. In this instance, when the main station halls are designed for mobility, a ticket sharer who wants to customise the given infrastructure to fit his or her goals must be comfortable with immobility – with stopping, with getting pushed by commuters, stared at and gawked at. The following passage from my field diary also shows the significance of waiting:

> I find a spot near the southern ticket station to stand, and notice two 20-something men standing by the railing near the ticket booth. They are waiting for something or someone. Both are playing with their mobile phones. I start to feel awkward standing around with nothing to do so I also take out my phone. The object creates a separation from my body and those around me. It builds a wall to my nakedness. A method of escape. An excuse to divert unwanted attention or eye contact. I also start to feel more normal with my phone, as if having it confirms to others that I am 'minding my own business' rather than staring at them, stalking, or being a voyeur. One of the trains to Kiel leaves, and then the one to Lübeck. The two men keep waiting. I move a little northward, and stand under the Lübeck platform. The other young man who was begging for money sees me again and this time comes up to me. He asks me in German for money, and I tell him I don't have any small change. He suggests that I can exchange a larger bill. I shake my head. He keeps walking. (field notes, January 2013).

This passage shows that when becoming static in a highly mobile environment, one suddenly becomes a protagonist of this space – a familiar stranger to other static protagonists. People take notice more because one's presence is not momentary. One is there, in that particular space, to stay for a while. Those searching out for ticket sharers also become protagonists of the train station, and those who customise the main station to their purpose. Moreover, making one's body visible also helps networks between others who also are customising the infrastructure in a similar way:

> I walk a few metres to the ticket booth where I was standing previously. I notice one of the young men who were standing there before approach a woman at the ticket machine and ask her if she is going to Lübeck. She shakes her head to indicate 'no'. He then notices that I was staring at them and asks me if I am going to Lübeck. I pretend not to speak German and ask him if he speaks English. He asks the other young man standing next to him, if he speaks English. The second guy says 'yes'. I explain that I often take trains and I want to know why they are asking other people if they are going to Lübeck. He tells me that it's 'way cheaper' to take a group ticket. 'So you ask people you don't know?' He says 'yes'. 'But how long do you wait?' The first guy answers me in German 'For the next train, and then if nobody comes, I wait for the following one. I do this for about an hour.' I explain that I understand and thank them for their information (field notes, January 2013).

Thus, the parasite grows and stabilises while moving through the host infrastructure in a way that use the host's resources, but also alters the host's intended use of its infrastructure. This manifests itself through bodily gestures that go unnoticed to those passers-by who are part of the host infrastructure. Yet these gestures also serve as a signal to others who are feeding the parasitic infrastructure, and becoming part of its system. Moreover, the parasite's body also serves as a beacon for others hoping to also join the process of customising an infrastructure. One body can help the orientation of another in navigating the rules of the parasitic infrastructure. When new practices like ticket sharing are in the early stages of being socially configured, every interaction between a stranger who knows about this practice and another who does not know risks being 'disorienting' (Goffman, 1983).

Clusters of people are also significant. Clusters are two or more people grouped together, usually standing in one place or slightly shifting from one area to another. The significance in the cluster is that they are either a) waiting for somebody or something (a train) or b) discussing with one another their method of action. The importance here is twofold: while actors also may wait for somebody or review their next methods of action, these processes are difficult to distinguish with the naked eye. A cluster has visual significance – a group of people bunched together in public space much more clearly conveys point 'a' or point 'b' as I outlined above. In the case of ticket sharers where groups of five people are required to use one ticket, the actor searches first for clusters and then, when none are found, moves one's sight to the level of the individual, and scans for signals which might reveal his or her intentions to share their ticket.

The Parasite's Rituals

Until now, I have outlined the way in which the built environment is customised to fit the parasite, as well as how the body is used as a tool to create the parasitic infrastructure. I also pinpointed the significance of flows (starting and stopping), and clustering. I would like to now outline the role that human-to-human interaction rituals – such as eye contact, solicitation, and gesturing, can play when forming the parasite. Significant human actors in the ticket sharing process are not only limited to the travellers searching for a cheaper ticket. There are also the ticket sharers, or more officially the 'peer providers' who first invest in buying the ticket, and therefore take the risk in finding travellers to share with before their train leaves. These ticket sharers can be divided into those who commute and do this 'non-professionally', and professional ticket sharers, meaning those who use the ticket sharing system on a regular basis to earn money.

The professional ticket sharers, (colloquially termed 'mafia', 'managers', or 'schleppers') invest in buying a ticket and travel back-and-forth between any given destinations, as many times as the time schedule and their willingness permits them to, searching for more people to share the ticket with. For example, a professional ticket sharer can buy a regional ticket for the province of Schleswig-Holstein for 49.90 Euros for five people. The ticket allows these passengers to ride around the region from the first train in the morning, to the last train after midnight. During the time of my fieldwork, there was no requirement specified by the DeutscheBahn that these five passengers must be the same people. Thus, the ticket 'manager' takes four people for 1.5 hours to Kiel, and then once in Kiel, searchers for others to come back with them to Hamburg. Based on my observation, a manager can sometimes make six trips daily, and earn as much as 3000 Euros monthly.

The interaction between these actors is highly significant in assembling this practice. The importance of gesturing, and the nature in which a ticket sharer approaches another is a delicate manoeuvre. The interplay between human and non-human actors is also very significant – how a person holds their ticket, where they stand by the ticket machine, how far away they stand from the platform – all become key in manifesting this practice. Note how important the ticket as well as facial gestures are in the ticket sharing process:

> Two girls walk by me. One of them holding out a ticket in front of them. They pass me. They then walk back and stop five metres in front of me and continue to talk to each other. They then look up and see me looking at them. They smile. I smile back at them and approach them. I ask them if they speak English. They say 'yes'. I then ask them if they are looking for someone to join their regional ticket. They say 'yes' (field notes, January 2013).

Goffman explained that, when in public, passing strangers generally uphold a non-written rule of non-solicitation. This rule can be broken only in certain specific cases: strangers can request certain free goods of each other when asking for information about directions and places. This type of request is often prefaced by an excuse for initiating talk and an alert regarding the search for information. For example: 'Excuse me, would you happen to know...' is normally prefaced before approaching a stranger, as 'asking someone for information they could not reasonably be assumed to have is a perceivably disoriented (and disorienting) thing to do' (Goffman, 1983: 38).

In the practice of ticket sharing, other forms of socialisation are also acceptable. I spot two people clustered together and approach them to solicit information about the destination of their journey. The issue in doing this is its awkward, embarrassing nature due mainly to the fact that in requesting this information, I risk that these two people might not know why I am asking them this question. Asking if somebody is going to Lübeck and using the group ticket is only a welcome solicitation for somebody who understands the rules of the game so-to-speak. Any signal (such as waving a ticket) between ticket re-seller and traveller (who are part of the parasitic infrastructure) might be indiscernible for the host (DeutscheBahn). Serres (1982: 142) explained by stating, 'look at the variety of languages and accents that mottle the globe. Here strangers understand nothing and signals are nothing but parasites for them. The signal proper is noise for a third, who is excluded.' The signal, here standing near a ticket machine and waving a group ticket, might be a signal to some, but noise for others.

Waiting for ticket sharers also involves an emotional engagement in the attention to others – a sensitivity to

those who are starting and stopping their journey, to the speed of flows circling around my own being. Significant are those who stop – those who look down at the ground or up at the train board. Every moment somebody stops they open up a chance that they are stopping to talk to a ticket sharer. This process also underlines one's level of activity, even in 'stopping and standing' – where the actor can approach others with their sight, attention, or desire to interact.

Shortly after conducting my fieldwork, in the spring of 2013, DeutscheBahn changed the regulations of the group ticket – requiring users to sign their names onto the ticket. This new regulation was implemented in order to avoid ticket sharing practices. This shift is also an example of the direct influence the parasitic infrastructure has on the main infrastructure. Here the parasite, through its actions, forced the infrastructure to shift its behaviour.

The Digital Parasite

As we explore how parasitic infrastructures are configured, the role of the digital is becoming increasingly central for the creation and robustness of the parasitic infrastructure. A growing number of apps and websites help the parasitic system use a mainstream urban infrastructure – often unnoticed. These digital platforms thus form an underbelly for these practices, helping ease or speed up processes of creating a parasitic infrastructure, mainly because the 'rules' of the new infrastructure are often written out online and made incredibly explicit. I would argue that ad-hoc searching out ticket sharers at the Hauptbahnhof, without knowing the rules of engagement, is both labour-intensive and socially awkward, as was already outlined in the previous paragraphs. Searching out a ticket sharer online, through a specific app or website, can help in coordinating the new ad-hoc system. To reiterate, in the case of ticket sharing, rules of engagement can be guessed and negotiated offline: an actor wishing to share their ticket can seek out spaces in the Hauptbahnhof where tickets are exchanged, one can gesture and place one's body out as a beacon of engagement. Yet doing so involves a labour that might not be part of the actors' intentions. The same actor can also use a platform like Mitfahrgelegenheit.de in order to make these rules more explicit.

At the moment of my fieldwork in 2013, Mitfahrgelegenheit.de was the most widely used train ticket sharing site in Germany. 4.5 million registered users and thousands of other unregistered travellers coordinated via this website and smartphone app. I noted that Mitfahrgelegenheit.de was often used to substitute waiting in the train station for somebody to come by with a ticket to share. The website minimised risk of finding another traveller, it helped with coordinating meetings – when one person buys a cheap group ticket to a given destination, they then log onto the website to find other willing train travellers to share the ticket with them, and set up the exact time and place they will meet. Most of the meeting spots suggested via Mitfahrgelegenheit.de were the same locations as the offline ticket sharers used. But the website helped coordinate the right meeting point within the train station (especially useful for new users), and helped calculate a time of arrival and departure as well as the material costs of such travel. Sociality is thus constantly being renegotiated as trust is manifested online and offline between strangers, before and during the journey.

An informal market has also developed online as well as offline – with entrepreneurs beginning to travel back and forth along regular routes, taking on multiple travellers per day. But they also gain travellers by advertising their trips via the website, and they also calculate and compute which trips would 'pay off' once travellers contact them via email or SMS, expressing their interest in a certain route. These

Mitfahrgelegenheit.de users developed their own processes of 'calqulating', meaning 'anticipating, measuring, testing, influencing and correcting the discrepancies between their own position' and that of their other ride sharers and providers (Cochoy, 2008: 30).

This doesn't mean that digital platforms provide instant solutions to various problems that can arise when building parasitic infrastructure. When interviewing the two female travellers (who appeared in a previous section of this paper), they told me: 'You should really then try this one website called Mitfahrgelegenheit.de.' I replied, 'I know that website. I've used it before. But why didn't *you* use it today?' I suggested this seeing that they couldn't find somebody to share their ticket with. 'We did use it, but nobody showed up', the other girl explained. The digital platform thus becomes an alternative form of coordination – a sort of 'plan a' or 'plan b' in coordination, but not the sole method used. If one parasitic system fails, the other parasitic system is there as a backup, and vice-versa. In this instance, the two girls did originally use the website, but had to resort to physically searching out others in the Hauptbahnhof, because the users of the digital platform did not cooperate. This mobility between the physical and digital method of coordination is characteristic of customising an infrastructure such as a train ticket sharing system.

Various apps and websites help contest existing infrastructures by providing alternative platforms to communicate between other ticket re-sellers or travellers, coordinate their travel times, and calculate their costs. While the digital holds an important role in helping to customise such infrastructure – specifically through its ability to help coordinate strangers, the body, the space, and the gestures of the parasite – based on material and bodily coordination, is still key to this system.

Conclusions

In this paper, I focused on low-budget inter-rail transport in Germany, with a specific focus on the practice of ticket sharing. The everyday practice of ticket sharing was used to show how improvised, spontaneous bottom-up systems are part of the story of how smart cities emerge. Though the metaphors of the 'parasite' and 'parasitic infrastructure,' I aimed to explain the ways in which internal flows of the city become redefined. Systems like ticket sharing networks are assemblages of human and non-human, digital and analogue actors, which can attach themselves to existent systems – acting as parasitic infrastructures. The metaphor of the parasite is thus useful as it goes beyond just explaining competing infrastructures as systems of power that emerge either bottom-up or top-down. The parasite refers to not only to the power one system has over the other, but also the dynamics in the relationship between the host infrastructure and its parasite. A parasitic infrastructure attempts to operate without the detection of the host infrastructure, yet it's detection effects the actions of the host infrastructure, which adjusts its behaviour to repel the parasitic infrastructure. Thus, as a concept, it helps explain the dynamism and relationality inherent in smart cities.

This constant relationship between the host infrastructure and the parasite is necessary to keep a city 'smart', as these systems are part of the collective intelligence that shapes the city. Moreover, the relationship between the host infrastructure and its parasite affects the functionality of such systems and helps provide alternatives to a given system. Parasitic infrastructures today are an inherent part of living in cities – and the emergence of such infrastructure is often made possible through the physical parasite (through re-claiming areas of a given infrastructure to create new meaning), the body of the parasite (through gestures and movement), and the digital parasite (platforms designed to help customise and

coordinate the body through a given space). Where a ticket sharer stands in the Hauptbahnhof, their positioning in relationship to the ticket machine, where they place themselves in relation to various other ticket sharers, and the platform where the train is leaving must all be taken into account. The process of scanning the actors at the train station for potential ticket sharing groups can also help in finding a ticket sharer – making the placement of the body incredibly significant. Moreover, various digital platforms help speed up the coordination of the body and space within which a new infrastructure develops.

Understanding how these parasitic infrastructures emerge – whether it is a bus ticketing system in Belarus, or German's rail ticketing system – helps uncover how systems of calculation and computation exist and emerge beyond just the digital. It also reveals how agency and power are distributed, stabilised or destabilised in cities today, generating knowledge about the dynamics of smart cities.

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Biographical Note

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Notes

[1] Grodno's Bus Park website is only available in Russian – see http://www.ap1.by.

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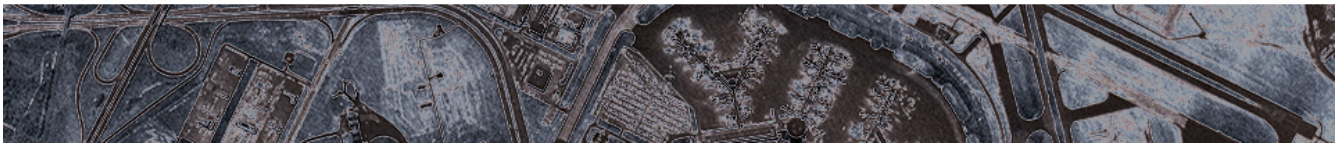

FCJ-219 The Sensed Smog: Smart Ubiquitous Cities and the Sensorial Body

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Abstract: This article approaches the technological city both from the perspective of sensors and as a conceptual thread that relates to air pollution. Smart cities carry forward their earlier technological legacy in infrastructure and often also in terms of the residual air pollution, like photochemical smog. The issue of the sensorial becomes a central focus of the article ranging from the experience of air pollution to its tracking and monitoring in remote sensing solutions. These two threads, sensors and the sensed city, lead to a conceptual argument that suggests to look at the technologies of smart city as an entanglement of the materiality and data.

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Air Conditions

There is not much that could not be represented in and as data. Things and processes, locations and addresses, the earth and its elements, and indeed, as emphasised in this article, air too can become quantified and then patterned as data that feeds as part of operations of governance. This begs the question: how do you govern by way of air? This article focuses on the smart city from the perspective of air – and especially air pollution – arguing that besides one particular example of the justification of smart cities, air is also a theme that ties the smart city into an earlier industrial legacy which still persists and offers a complementary way to consider the technological city.

It is already on the level of particles such as dust (Parikka, 2015: 83-107) that we encounter political dilemmas of inclusion and exclusion, exposure and security. Dust and air pollution in general are silent, violent aggressors that demonstrate the political urgency of the atmospheric condition: the age of modernity is one of bubbles and spheres, as Peter Sloterdijk (2011) argues referring to the constitution of subjectivity as an air conditioning operation. Modernity opens up as air conditioning and as airborne terror: of denying possibilities of breathing the air of the streets and the public spaces. Terror begins in and with the air (Sloterdijk, 2009). This claim connects political contexts of cleaning and dusting to the issues of

chemical warfare. Such warfare is not merely an issue of the usual armed conflicts, but an increasingly naturalised part of security regimes that govern the urban sphere: an air of gas and clouds, of molecular combinations designed to turn the social breathing space into a space of suffocation (on tear gas, see Feigenbaum, 2017). This became evident in the past years of security politics of excessive tear gas use as a quasi-military form of urban sanification against social movements. Examples are plenty, including the infamous case of Turkey during and after the Gezi demonstrations in 2013, but also more recently, the use of tear gas against environmental protestors during #COP21 in Paris. The list could go on and includes a longer history of the normalisation of such techniques of the denial of air. The commons of the air is quickly turned into a commons of the unbreathable, although with the striking difference of gas masked police enjoying the personal sphere of breathing. The gas mask becomes a key symbol and operational item of the modern era of subjectivity (see also Soncul, 2015). [1]

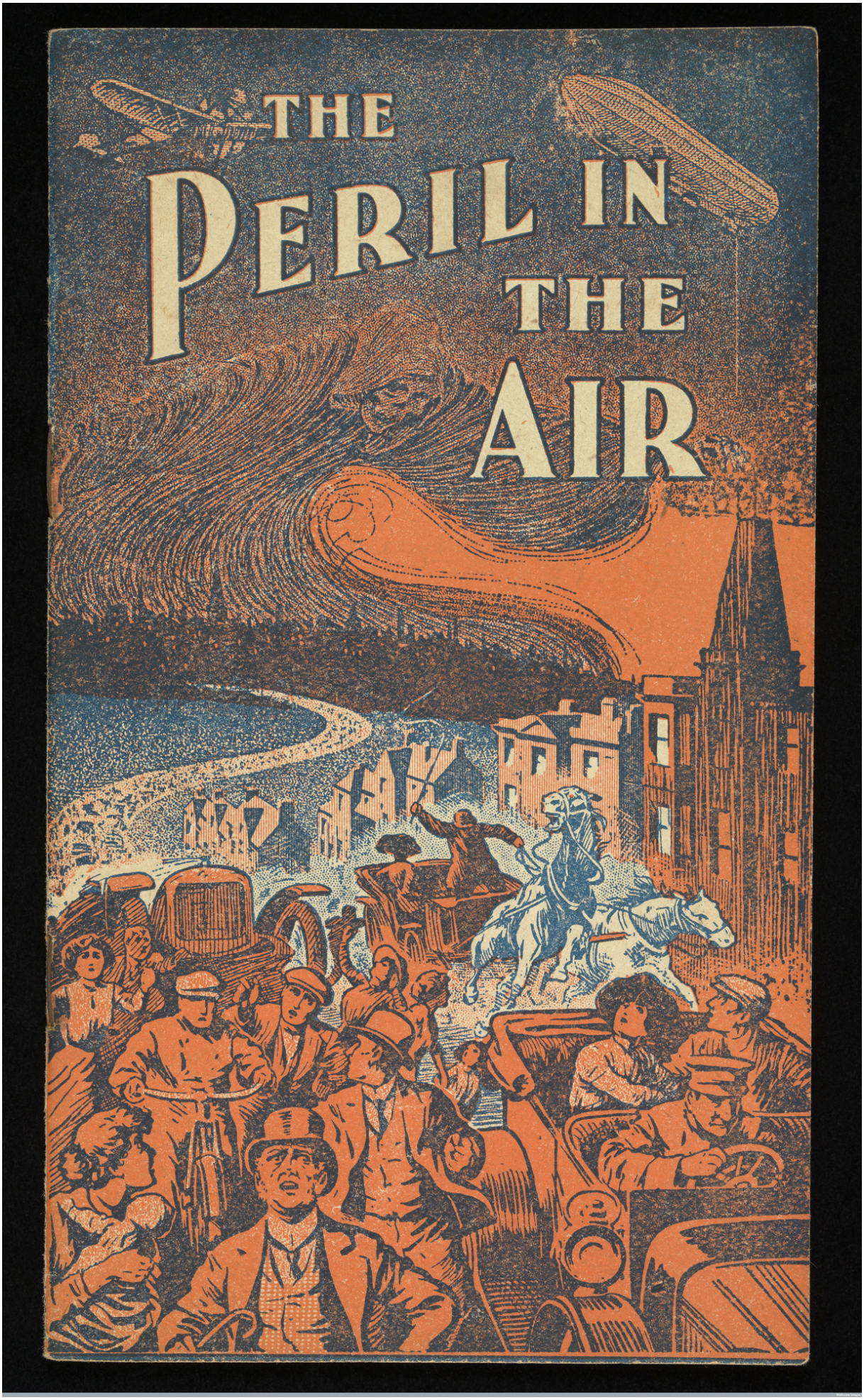

Figure 1. An advert for cough and cold tablets from 1913 captures some of the early connotations of airborne terror:

cities are sites of modern ills from factory pollution to lung diseases. Credit: Wellcome Library, London, available under Creative Commons Attribution only licence CC BY 4.0.

There is also a low level of slow violence (see Nixon, 2011) that is the background screen of industrial modernity. In other words, from the specific events of denied breath, we can move on to observe the wider sense in which bad quality of air is an issue that is itself a normalised and yet violent part of the conditions of living. We can name this a slower and more inconspicuous form of warfare that is expressed often in other sorts of vocabularies such as environmental problems, the Anthropocene, sustainability and/or pollution. The Anthropocene is a term that emerges in the scientific discussions of geological periodisation but has become a sort of a placeholder for the wider impact and effects of human-made climate change that moves across lands and seas, atmospheres and even space (space junk). Furthermore, the assumption of a generalised 'human' as the agent in this period has been challenged with calls for more geographically aware, gender-specific and politically aware analysis of the role of capitalist modes of production and consumption (see for example Haraway, 2015). The Anthropocene becomes a coordinate, and one recurring term in narrativising this condition and hopefully also facilitating an understanding of the links between the biological, the economic and the political spheres of interactions. It has also been proposed that there is a specific value to approaching it through the lenses of art and the wider context of aesthesis that accounts for the reality of the Anthropocene as 'a sensorial phenomena: the experience of living in an increasingly diminished and toxic world' (Davis and Turpin, 2015: 3). This experiential layer also expands to the wider sense in which it is being produced as a technological reality – a layer of planetary computation (Bratton, 2016) that works by way of sensors, data visualisation, satellites and more (Davis and Turpin, 2015: 3-4).

Besides a chemical issue, air pollution is in many ways visual media you breathe. Photochemical smog that covers many global metropolitan areas consists of Nitrogen Oxide (NO), Nitrogen Dioxide (NO2), Ozone (O3) and Volatile organic compounds (RH). This is the elemental media condition across the aesthetic landscapes of contemporary industrial and post-industrial life. An urban screen, hovering above the cinematic megacities of Los Angeles, Istanbul, Beijing, Sao Paulo and many other places, is a residue of the transport cultures of automobiles as well as other sources of fossil fuel culture. It is also like a media archaeological chemical residue of the old in the contemporary. In cases like earlier 20th century Istanbul, it was coal that released a black cloth over the city that Orhan Pamuk described as a screen of *hüzün*, the feeling of melancholia: 'On cold winter mornings, when the sun suddenly falls on the Bosphorus and the faint vapour begins to rise from the surface, the hüzün is so dense you can almost touch it, almost see it spread like a film over its people and its landscapes' (Pamuk, 2011: 122). It was less poetically serialised in the various images of masks of London inhabitants that one finds in archives. They picture the modern London before the 1956 Clean Air Act gradually started to address the issue that was most violently summarised in the infamous 'Big Smog' of December 1952.

Smog has of course not disappeared. Nowadays, smog is more likely to follow from the extensive private car traffic that characterises this city and so many like it at least in terms of their chemistry. It presents itself in slightly alternative visual ways and in different forms, but it is something that also can be addressed through questions such as: what are the conditions of visibility of air pollution? What are the conditions of chemical composition and the political-economic distribution of smog? Smog is then, besides a reference to a specific form of air pollution, also a conceptual bridge between the industrial and the post-industrial computerised city, a bridge between the production of the molecular pollution and its registration as part of the digital city, the smart city sensors and data. [2]

Questions concerning air quality converge into one crucial question in the debate concerning the modern and smart city. The question of air and pollution cuts and divides insides and outsides, breathable and polluted spaces in subtle, informationally observed ways. Technical definitions and questions of air also have a relation to smart cities as cities of measurability (sensors) and processing of data. The computational data points that allow 'management of uncertainty' through the constant monitoring, optimisation and 'penetration of computational interventions' (Halpern, 2014: 27) are part of emerging city plans. This ranges from idealised custom-built tech cities such as South Korea's Songdo to Spanish Santander, which is the European Union's well-funded test case for the massively sensored city (Newcombe, 2014). Besides the computational, there is also a seemingly more archaic form of media that comes through the toxic materials in the air. This latter point refers to a sort of a veil, a screen that hovers across the everyday in the megacities of the current climate.

This article focuses on the urban environment as defined both by the emergence of the new forms of measurement of the city – and its airborne pollution – through smog sensors. I will also envelop this more straightforward assumption as part of a conceptual argument: what does it mean to look at smog as a medium itself, and to approach it as an index of the technological city that is haunted by the industrial veil. What conditions this 'looking' and even 'seeing the city' through eyes that are often data, and often statistical, such as art projects like *Seeing the Air* (Gates and Sampath, 2015)? I am interested in photochemical smog as a screen media of the city and pollution's relation to smog sensors, and the creation of breathable zones. Many of the problems we identify as 'environmental', like air pollution, are already discussed and operated as data (both analytic data and as financial data, traded in the offset markets). Hence I choose to discuss the two in parallel: the environmental as part of a media ecology of observing, measuring and processing of data. To follow John Durham Peters (2015), the consideration of the environment and its elements as media must also lead into questions as to how the media technological framing of elements leads recursively into an alternative view to nature through those technological frameworks. Air is one crucial media environment in which sensation happens, but air is not the same in technological culture, let alone in the remote-sensed data city-cum-lab, as it is in a purely scientific, chemical definition. Air has its own life, and its own history, and in some parts this history becomes part of media and art history, as articulated below.

The text addresses the question in the three following sections. Following this introduction, I want to discuss the smart, modern city defined by its unwanted elements, in this case pollution and waste. Issues of sensing and perceiving pollution become key parts of political subjectivity in the urban environment. Two kinds of sensing perception are then discussed. In the second section, this starts with a more conceptual, and even aesthetic, discussion in relation to smog as visual media or environmental art. In the last section, issues of smog sensing, design and political citizenship are addressed. I draw widely on recent key theorisations and projects while myself offering a cross disciplinary discussion that can provide a conceptual lead which complements the earlier work as well as some current art projects (for example Susie Pratt's art practice and Amy Balkin's *Public Smog (2004-)*, which are both briefly discussed but also informative of the conceptual developments in this text). My addition to those analytic and artistic works is a theoretical consideration as to how to conceptualise the existence of the various overlapping milieus: the persisting pollution as legacy from CO2 heavy energy forms, transport and such; the data milieu in which air is being registered; and the forms of subjectivity which also register and sense the urban pollution.

The City and Its Residues

The media city refers to the infrastructural redesigning of urban environments both in terms of certain areas of clustering media industries into innovation hubs and parks and as the infrastructural implementation of systems that offer new data-enhanced services, information and interfaces to urban life. This latter is part of the idea of smart cities that promise optimised ways of addressing intensive urbanisation. It is interesting, however, to observe the disconnect between the custom-built shop window smartness of places like Songdo in South Korea and Masdar in Abu Dhabi (UAE) as the example cities of a green sustainability supported by corporate funds (including Consensus Business Group, Credit Suisse and Siemens Venture Capital) and the real existing cities where solutions of 'smartness' relate to the layered histories of the place. As smart city writers such as Anthony Townsend underline, 'the vast amount of people living in cities don't live in cities like that right now' (in Mathis, 2014). Urban issues are actually of a different scale and don't seem at first to touch the narrow smart city focus at all: 'It took 10 years to build Songdo and Masdar, which each house maybe 100,000 people, and in the same period, we've added hundreds of millions of people to the next big cities of the global south' (Townsend in Mathis, 2014). In other words, we are rarely 'starting from scratch' (*The Economist*, 2013).

Actual population growth, environmental questions and climate change, difficult ecosystems of cities and their surroundings, and for example supply of food and fresh water, are the issues for future of cities (see Sterling, 2013) as much as current planning. Hence, as Halpern and Günel (2017) demonstrate, the current smart city plans including Songdo but especially Masdar City in Abu Dhabi are implicitly enveloped in a narrative of emerging environmental catastrophe. What the authors describe as the tie in between 'speculation on disaster' and the 'sentiments of hope and optimism' becomes a way to frame the symbolic function of smart cities and also their design plans. The science-fictional style of the plans works to enhance the realization that 'Masdar City is promoted as a utopian living arrangement that acknowledges and resolves the current energy crises of the world, while mitigating climate change' (Halpern and Günel, 2017). In other words, the emerging global climate crisis is what prescribes a sort of a flipside of what is meant as utopian narrative of future cities: instead, it produces suspicions of dystopian gated enclaves that become resilient against the environmental and social issues that define current metropolitan landscapes. In the case of Masdar, the plans have a specific relation to imagining a post-oil Middle East luxury lifestyle, but more widely they point to issues of thinking climate change as incorporated in technological infrastructures. What's noteworthy is that some of these, like Masdar, are already discussed as 'failed experiments' (Herzog, 2016) in their own right.

Such analyses of smart cities acknowledge how current urban development works in the context of global problems as well as historical contexts. These critical insights also take into account the specific dynamic temporalities that define cities here and now. They recall the fact that media (as technologies and techniques that enable perception, sensation, habit) are built on top of existing infrastructures from the organic to technical media (see Mattern, 2015; Mattern 2016; see also Bratton, 2016). Cities present themselves through archaeological layers that can be excavated through various signs, systems, infrastructures and traces left behind. Many global cities also include an interface with an industrial legacy as well; this presents issues that include for example the residual of the overgrowth of cities, pollution and waste management. Different bin solutions present an amusing showcase of what smart cities could be as waste management.

But such solutions always include much more in them than just the primary function of waste collection: the start-up behind the London smart bins suffered a blow after it was revealed that the pods actually track the MAC addresses of smart phones in the vicinity (Vincent, 2013). Indeed, waste is never just waste but an access point to a wider circulation of information and value creation, management of the wanteds and unwanteds of the city. Dominique Laporte (2000) in the *History of Shit* argues that the emergence of the modern infrastructural city is also a site for the production of modern subjectivity. The production of cleanliness became part of city planning as a way to install order; the emergence of bourgeois subjectivity of segregated spaces is partly visible in the measures taken to install sewage and other systems of waste. Furthermore, this was not merely an issue of closing off the unwanteds, but of designing certain ways in which this circulation can be managed productively. The city is where waste turns to gold by way of purification and privatisation of even the seemingly most unnecessary:

> under the seal of divine power, the city – site of exchange from the earliest moments of generalized circulation – was similarly subject to purification. Whether belly or granary, the city is that place where merchandise accumulates and is consumed before being turned into gold. To purify the city, one must enrich it in a manner that makes way for the means of production. But shit cannot be converted into cash through mere elimination. Before its restitution in sublimated form, it must nourish the very cesspools of its production (Laporte, 2000: 26).

Waste and also contemporary pollution present a convergence of environmental and political issues as part of the media ecology of the city. Ecology is here a broader term than the environment and refers to the various cultural, political, historical and media contexts in which issues of the environment are conditioned, measured, represented, discussed, and materially transformed into other spheres of interaction (see for example Andermatt Conley, 1997; Fuller, 2005). Besides the literal and proverbial excrement analysed by Laporte, I want to contextualise this discussion in air pollution, followed by the various contexts in which the ubiquitous city is localised and datafied with sensors.

I want to propose a couple of detours and twists in the way in which we understand the city, its political citizenship and smog – the haze that is a companion of industrialisation and persists as the haze of the supposedly post-industrial: tiny particles that create an odd sort of a media city that is technological in more ways than the smart city discourse assumes. One is tempted to claim that this is how the city looks in the Anthropocene: defined both by its waste and pollution as remainders of the industrial legacy, fossil fuel age and insufficient waste solutions and by the data-intensive measures that aim to offer an understanding of this chemical reality of the Anthropocene and turn it into an excessive calculation, storing and financialisation of that data. It is registered in the various sensors, tracking, calculating, visualisations and statistics that are the quantified and then datafied basis of the city. The chemical reality and the data about it are interlocked. In other words, accounting for the layered infrastructures as well as historical legacies of the city reminds us of the old problems new technologies are supposed to solve: smog from industry, transport that is the existing legacy of the 20th century, and the old energy forms still firing up technological society, based on coal etc. This is the particle world of technological cities we inhale: the dirty dust and smaller molecular elements that ensure that air is never *just* air (Protevi, 2013: 46). The air also includes harmful chemicals that then mix with our insides, violating the basic line between the self and the non-self in a continuous mock example of the 'democratic' city: we all share the pollution. Of course, this is not entirely true, despite such writers as Ulrich Beck, who much earlier in the 1990s argued that 'poverty is hierarchical, while *smog is democratic*' (Beck, 1995: 60), illuminating also how the distribution of bads is

'democratic'.

In Beck's risk society vision, it is this inequality in the production of bads that is distributed across the urban social layers. Additionally, environmental hazards become a shared common just like air and land is meant to be (Cottle, 1998). And yet, through urban planning and the systematic production of the city that reproduces and reinforces ethnic, economic, and other divisions, issues of air pollution are not equally shared by all. This is a theme recognised in critical urbanism, for example in the discussion about politics of infrastructure cities have for a longer time been part of a production of inequality through infrastructural choices, such as water and sewage (Tonkiss, 2013: 148-149), and we can discuss similar issues in relation to the seemingly more ephemeral dystopia of the air, too. Any discussion of the environment(al) needs to be a discussion of the ecology of multiple 'social, political, ethical and aesthetic dimensions' (Braidotti, 2006: 123). Hence, more than environmental consciousness, the ecological analysis presented here accounts for the geographical and political distribution of waste, the situated nature of pollution, and the political economy of solutions offered as part of the management of the issue both in cities and globally.

In places like Zhengzhou and many other Chinese cities, smog persistently consists of residues of fossil fuel burning and particulate matters such as PM2.5. Such a situation is not because of the lack of regulations, but the problems in enforcing them effectively. This issue is made evident in such material as the online documentary *Under the Dome* (2015) by Chai Jing, featuring the subject of Chinese air pollution and the disconnect between regulations, economic mandates and local levels of enforcement of standards. Furthermore, news pieces, images and stories about Chinese smog problems threaten to ignore the issues that are prevalent in a lot of European cities. London for example is among the cities that have failed to follow up on required limits for nitrogen dioxide (McGrath, 2014), underpinning the other side of the story: invisible air pollution does not as easily transform into a stream of media representations about smog cities. Not all air pollution is visible, a twist that should not be ignored in the discussion of this visual media that is another entry point to the sensor and data-registered ways in which we understand the chemical atmosphere of the technological city. Further emphasising the point about uneven distribution of visibilities as a matter of political geography of slow violence, Nixon (2011: 64-65) reminds us that the narrativisation of global environmental catastrophes also follows the logic where 'some afflicted communities are afforded more visibility – and more access to remediation – than others through the mechanisms of globalization, environmental racism, and class discrimination'.

From coal smog, diesel fuel burning and other sources, the archaic elements of the planet are enfolded even in the 21st century version of post-Fordist capitalism that is fuelled by the earth's fossil political economy (see for example Szeman, 2007; Salminen and Vadén, 2015). The relevance of considering energy solutions as part of the wider technological infrastructures of smart cities reveals at this point more than just questions of smart monitoring: it is, instead, a bigger infrastructural issue of political economy that depends on certain environmentally disastrous energy forms. Indeed, as scholars are nowadays again noting, questions of technology are not restricted to the urban but are distributed across vast rural areas too (Starosielski, 2015). The question of perception and sensing the urban and its problems is one of the key issues that sustains the smart city as a technological assemblage: a smart city is a sensorial city, where perception is partly displaced onto the specific sensors and their analytical backend. But before going into issues of smog sensing, I want to propose an alternative, conceptual and artistic way of thinking about smog itself already related closely to media in and of the atmospheric.

Aesthetics of Smog

One step in conceptualising what pollution and smog are as a sensed reality that are experienced and yet not entirely reducible to human sensation is to offer the following suggestion: think of smog as a chemical screen, even, chemical screen media. The sun enlivens it with light, which is the most fundamental thing in visual culture. The screen is not a background but an environment that wraps you inside its toxic cloud. We register this sort of visual screen with our bodies with every breath but also with different sorts of sensors that have developed as an essential part of the observation of industrial culture. For us humans, ironically this sort of visual screen arts *irritates* the eye – molecular elements such a Peroxyacetyl nitrate and ozone don't obey the visual distance that is necessary to form an image, but act directly as part of the visual system. It is within this experienced chemistry of the city and its toxins where the experience of its pollution starts.

Imagine writing the history of media cities from this perspective that seems to borrow ideas from experimental aesthetics and art methods: The Anthropocene has become the commonplace name for radical environmental changes but it is in certain ways also a new art historical period that is measured in lung diseases and cancer rates. The environmental catastrophes produced as part of industrialisation – or what is nowadays often called the Anthropocene or Capitalocene (see Haraway, 2015) – are measures of this other register of visual and tactile history. For instance, the ozone depletion period since the 1970s visualises a concrete change in the conditions of light of the planet.

For a sketch of an alternative ecological art history (on art and the Anthropocene, see Davis and Turpin, 2015), one could claim that ozone depletion relates to radical molecular art since the 1970s. The 1970s mark a visual art historical period caused by photodissociation of key chemical agents such as CFCs, freons, halons as well as solvents, propellants, etc. It is a weird period when one starts to consider it from this perspective: problems of refrigeration and the invention of products such as freon have their residual aftereffects in the upper atmosphere which, as historian John McNeill notes, have not really until now featured as an important role in human history. Usually things that concern us have happened in the lower spheres of the planet (McNeill, 2000: 52). History has been atmospherically biased towards things much closer to human headspace. But the modern historical period rather concretely consists of carbon dioxide, ozone and sulphur dioxide (McNeill, 2000: 52), too, and this is not a feature restricted to that one particular narrative-atmospheric space. The massive increase in CFC (chlorofluorocarbon) amounts has resulted in what could be called the 'ultraviolet century' (McNeill, 2000: 114). The effect of the ozone depletion as we have grown to know it, is the increase in penetration of UV-light/radiation through the stratosphere, resulting in a different light balance from the 1970s to approximately to the year 2070 (as the restoration of the ozone protection layer is a slow process). This form of art historical period is registered on the skin and the organisms of humans as increased cancer rates; in animals such as whales as similar epidermal reactions (Thomas, 2010); in plants and crops, etc. Smog itself is also visible in the increase in cardiovascular diseases, asthma and lung inflammations, asthma for example.

Environmental histories of smog can also contribute to this alternative art history (see also Mirzoeff, 2014). This sort of art history is oddly connected to photochemical trails and their industrial transport roots: cars and their routes, part of the infrastructures of modernity. Besides industrial pollution, smog is a question of what is experienced and registered on the organic body but it is also in peculiar ways a technological question. It relates to both the technological production of the chemical world that defines contemporary

culture and the specific political-aesthetic allocation of this as a material, sensed reality. This is a dividing and partitioning of spaces, breathability, and visuals of the city (see also Rancière, 2004). Who has to see and suffer from pollution is a question that should be put on the agenda of aesthetic theory, too. [3] This is a situation where visual politics, politics of breathing as well as politics of sensoring are negotiated. It is also the target of other sorts of campaigns that are perhaps in spirit close to Sloterdijk (2009, 2011) (defining questions of modern subjectivity are ones of breathing and air control/atmosphere), but executed by various alternative means. The very real problem of breathability becomes the site where the various forces of technological, economic, planning and design form the urban subject.

Addressing similar themes by way of art methods, artist-scholar Susie Pratt (2014) mobilised a way of relating to smog as part of a case study of Hong Kong. Pratt engages with the human sensorial through the 'taste of smog': cultural practices of domesticating the urban problems of smog are made into a synaesthetic experience with a palette to match the air-born pollutants (Pratt, 2014). Smog imposes itself as a bodily experienced phenomenon, where its molecular status becomes also registered in and on the body. The lungs are open to the outside every minute of the day as an involuntary organ archive of the pollutant levels, registering the chemical century like lichen does in nature. The work of remote sensing, and smog-sensors is pre-empted by the fact that humans and non-human animals are constantly enfolded in such environments that open up as the new media of visual sense: embodied relations to air pollutants are perhaps not expressed so much in quantitative terms but in qualitative, affective and also in aesthetic expressions. This leads to an evaluation of the city in visual, tactile, and even gustatory senses, as Pratt demonstrates in the speculative but highly effective way of framing citizen sensing through art methods.

The environmental is sedimented and folded on various levels in the city and in the atmosphere. The molecular chemistry that surrounds the cityscape is one that is not merely an object that stands apart from its background but a molecular reality that entangles with multiple scales. In some ways, we need to be aware of the already existing residual technology of air pollution and other industrial layers that define the backdrop for current monitoring and sensoring of the city. This is not merely an issue that relates to technologies of sensing, but to the wider sensorial, including that of the aesthetic distribution of how we perceive the atmosphere, for example, smog. Besides that, remote sensing technologies are a non-human registering of the molecular levels of what we perceive as mediated and audiovisual; the realisation of the air as an active ingredient in an everyday living space is a continuation of the climate conditioned condition of modernity. Fresh air can even be staged as a commodity, as the artist Lian Kegang did in his performance involving packed fresh mountain air selling for 5,250 yuan (Stampler, 2014).

In a similar vein, a much earlier project by Amy Balkin staged the conceptual and atmospheric site of *Public Smog* (2004-). An art project that addressed emissions trade, the legal constitution of breathability, and engagement with the wider public in relation to various governmental and intergovernmental organisations, it functioned also to demonstrate the sites and non-sites where pollution *takes place* geographically and atmospherically. In Balkin's words and the project description: '*Public Smog* is a park in the atmosphere that fluctuates in location and scale. The park is constructed through financial, legal, or political activities that open it for public use'. [4] The project attempted to buy emission offsets in order to be able to withdraw these from the financial trading market. As a way of buying back air, it created sites in the atmosphere that were public parks. Furthermore, the project attempted to reach out to UNESCO to register 'Earth's atmosphere, from sea level to the Kármán Line (100 kilometres above sea)' (Balkin, 2015: 344) on the World Heritage List. *Public Smog* is about situations but ones that are in movement: the

dynamic transactions on the market that deal with financial data concerning emissions and offsets, the atmospheric conditions, including wind, gas and aerosols, the legal bodies of global reach concerning heritage and preservation and more. [5]

In peculiar ways, Balkin's project was at the same time extremely grounded in issues of livability and yet reaching out to the various abstractions in which the sensorial dimensions of pollution are mediated. The project also extended to locations such as Douala, Cameroon, and was visible as large billboard installations that were spread across the city, described by Balkin:

> A mix of rhetoric, boosterism, greenwashing, and political agitation, the slogans interweave dystopian narrative and political critique, setting the technocratic language of the Clean Development Mechanism (CDM) i.e. "Public Smog is CDM Gold Standard", against "Public Smog Offsets Tomorrow Today" or "Public Smog is No Substitute for Direct Action". (2016)

Figure 2. Public smog offsets climate justice. Billboard, Ndokoti, Douala, Cameroon, 2009. Image: Benoît Mangin. Part of Amy Balkin, Public Smog, used with permission

Highlighted by such artistic methods, a focus on air pollution and smog, income, race and class differences can be further reproduced and enforced by way of breathability and air quality. Bodies are already sensorial registers, much before and in parallel to remote sensing in the ubiquitous city. Or, in short: some bodies are more exposed than others. Next, I will continue investigating the issue of the sensor in the computational, smart city and combining the two different, yet complementary approaches to what and where the sensorial happens.

The Sensored City

Technological residual is part of the political ecology in which sensoring, monitoring and the proclaimed smartness of the city has to be acknowledged. Part of the issue is that in many instances, contemporary air pollution is not visible to human eyes. Even if, as outlined above, the pollution registers itself on the body, not all current problems come down to the visible smog layers above cities such as Santiago, Istanbul, Sao Paulo or for example the infamous situations in many of the megacities of China, where smog descends on the streets in a much more imposing manner than in other metropolises.

Air pollution has of course also spurred a wave of activism. This has led to a lot of citizen-led work with sensors as a way to capture back the right to monitor and report the invisible constitution of the environment. In many ways, this suggests an alternative way of approaching the smart city than that of the high-tech shop windows. Instead, the idea of the city as a demo (see Halpern and Günel, 2017, in this issue) is brought back onto a grassroots activity in such forms as Citizen Science at the Innovations Lab in Kosovo. [6] The polluted city is made accessible by way of a Lab that offers aesthetic, technological, and epistemological tools to interface with the issues that concern, for example, air quality.

Such activism is taking place in varied situations and different political climates. Quite often the issue mentioned is about access to data as well as aesthetics (understood as the fundamental *aisthesis* of and in the world): both equate to visibility in the context of allocation of air quality. As articulated by one activist in Portland, Oregon (US):

> 'The problem with air pollution today in America is that most of it is no longer visible,' said Peveto. 'In the 1970s we were dealing with smog and envisioning L.A. and these basins of yellow smog. Today the insidious air pollution problem is largely invisible to the naked eye, so having the technology that can make the invisible visible through data and numbers is important to realizing change because we need awareness before we have change' (Intelfreepress, 2013).

A lot of sustainability and activist movements turn to data and the remote sensorial as ways to interface with the issues of pollution. What is interesting is the backstory about the corporate infrastructure supporting this grassroots investigation and analysis by way of providing low-cost sensors, tapping into the possibilities of data capture by way of activist work. Intel provided the hardware that is driving the distributed network of citizen remote sensoring that is described as light, cheap and open source.

> The sensors weigh less than a pound and are built using an open-source Arduino microcontroller that is available on Amazon and at many electronics stores. The sensors measure carbon and nitrogen dioxide emissions, temperature and humidity, and can be upgraded to measure particulate matter, ozone conditions and volatile organic compounds.
>
> In addition to the 17 in Northwest Portland, there are more than 200 other 'egg' sensors around the world now feeding real-time air quality data for anyone to see. Once a sensor is installed and registered at the Air Quality Egg website, its live data can be seen online at Xively, a public cloud service for the Internet of things (Intelfreepress, 2013).

Issues of seeing are increasingly dealt with in terms of visibility of data even if the infrastructure of how

data is being collected and with what effects is more interesting than merely visual perception. [7] For example, the visualisation project *Seeing the Air* engages with air quality data from selected cities including Boston, Bangalore, Rio de Janeiro and Shanghai and provides a variety of graphs that enable comparison over time, between cities and categories of the AQI (Air Quality Index). *Seeing the Air* makes pollution understandable through expected representations of sensor data. The API-driven way of presenting the invisible life of cities as data visualisation is however in danger of missing the question of what data is been seen, and where it connects, if anywhere at all. Is there any political efficacy that deals with the data produced?

The sensored and monitored city is an interesting combination of two lineages. It might hark back to the cybernetic ideals of control through feedback that emerged gradually since the 1950s and had an effect also in the way that cities are thought about (Halpern, 2014). But the actual story of cities of the post World War II period has been rather different than the cleaned cybernetic face that now finds a new articulation in the smart city. From the cybernetic fantasies of the 1960s to the smartness of the urban architectures of the 1980s and the 1990s, there is similarity in terms of the persistant pollution levels in numerous urban locations, despite some shifts in energy sources towards ones that cause less smog and heavy particles. The city planning that increasingly takes into account the possibility of green planning through 'smartness' can however be contextualised as part of broader questions of ecology and visual politics (Gabrys, 2014). This has been recognized and even used as justification for smart plans, to quote Jennifer Gabrys, a key scholar of the cultural contexts of sensors and who is leading the significant European Research Council funded project 'Citizen Sensing and Environmental Practice':

> While cities are centers of economic growth and innovation, they are also, as smart-city advocates argue, sites of considerable resource use and greenhouse gas emissions and are therefore seen to be important zones for implementing sustainability initiatives (Gabrys, 2014: 31).

The sustainability initiatives themselves are at the core of the current corporate rhetorical justification of smartness. From current marketing campaigns by Microsoft and others, it is the goal of environmental sustainability that sustains the cloud as the solution for a wide range of systems and contexts, from cities to businesses – and cities as businesses. Of course, there is a direct angle to environmental pollution, too, but it is important to note how the issue of sensors articulates this in concrete locations, in global contexts and within urban areas.

In several ways it is the existence of environmental problems that spurs the mobilisation of technological solutions such as massive level smog sensoring coupled with big data analysis. Here, the connections between remote sensing, smog sensing and environmental sensing are forming a crucial node in terms of producing the feedback-looped citizen/ smart environment. The smog disaster cities of, for example, China, produce massive amounts of data from sensors and other sorts of input for scientific research based on quantitative analysis of pollution levels together with the circuiting of smog sensors, social media data and big data analysis as to the geographic/location based distribution of the issues, which are taken as the synthetic chemical screen of the city itself. Big data and big sensors become ways to collect and process environmental data in 'monitoring, which can better guide people's behaviour and government strategy design for smog disaster mitigation' (Chen et al., 2014: 510). People become functions of the data flows as both its sensors (through social media messages for example) and as its quantified subjects, while the issue of the political itself is rather left grey: monitoring does not necessarily mean any sort of a political follow-

up. Interestingly, social activism is here supported by corporate hardware and issues of policy become more central than questioning politics of infrastructure.

Many projects concerning coordinated data sets from sensors to social media messages become a way to mobilise computational solutions and infrastructures, too. These include Apache Hive-system based information warehouse solutions and real-time computation systems such as Storm (also Apache based and open system, offered by Hadoop), which demonstrates how chemical residues spur data. Management of the environment means also management of the data about the environment. Any environment includes also the data about itself, the wider media ecology. This refers to the informational ecology able to store, handle, query and process the data that also changes our understanding and relationship with the environment. It is on this level of the computational infrastructure where the old technological urban pollution such as smog from transport meets the new infrastructures that are built in relation to it: monitors, computational processes, data storage and more.

Gabrys (2014) investigates some key smart city projects in terms of how they have mobilised notions of environmentality and the subject as part of the agenda of sustainability. In a way, one could see these projects as a direct address to the technological city as the polluted city, but with an added sense of the redistribution of power. It is a visual production of the city as per its statistical distribution of pollution levels in terms of graphs – and also in terms of apps that allow mapping of the city according to its pollution levels, adding another layer to the more chemical sense of smog as media. Monitoring is not necessarily only remote either – but literally mobilised by mobile researchers who track the existing infrastructural routes of the city. By moving along the existing channels of transport and communication such as ferries, subways, and pedestrian roots in cities like Hong Kong and Shenzen, this kind of research becomes a way to see how air quality varies:

> Another innovative experiment in capturing highly localized air quality data was recently conducted in the cities of Hong Kong and Shenzhen. Instead of locating fixed monitoring stations around these cities, researchers at the MIT Senseable City Lab attached small sensors to their wrists and belts and then traveled along standard commute routes on ferries, subways, and on foot. The sensors gathered data for carbon monoxide, nitrogen dioxide, temperature, humidity, and noise and monitored PM 10, a measure of coarse inhalable particles. On their calves, the researchers strapped a GPS and camera to track spatial information. (Cooley, 2014)

In other words, the air-borne pollution that defines the modern subject in relation to its breathing conditions, that is, air conditioning (Sloterdijk, 2011), triggers also questions of governance and subjectivity, of urban sites and movement in and across such locations. These are issues that also Gabrys focuses on. However, she is interested in how this can be read through Foucault's vocabulary where 'environmental technologies as spatial modes of governance might alter material-political distributions of power and possible modes of subjectification' (2014: 32). Indeed, offering a contribution from the perspective of Science and Technology Studies (STS), this angle is less a question of individual subjects than the enfolding of the urban citizens as 'sensing nodes – citizen sensors' where issues of environmentality, sensors, mediated logistics and political subjectivity become knotted.

As Gabrys (2014) outlines, the participatory citizen is nicely fitted in as part of the environmental management in a way that corresponds well with Michel Foucault's (2007) analysis of territories and

security: instead of controlling individuals, environmental management creates environmental conditions in which certain sorts of behaviour and end results are produced. Foucault's outline of the genealogy of 'case, risk, danger and crisis' (Gabrys, 2014: 61) as particular terms that function in the context of security is in many ways pertinent to our interest. Foucault tracks the importance of these mechanisms through contagious diseases, and his analysis pays attention to the centrality of the (market) town as a territory of contagion. Furthermore, the focus on territorial and statistically-managed security is something, he observes, that is not being nullified or denied but addressed by way of containment; these are mechanisms of control and security. This approach could be a relevant way of understanding also air pollution linked to security issues that 'involve the delimitation of phenomena within acceptable limits, rather than the imposition of a law that says no to them.' (Gabrys, 2014: 66). In other words, the issue is less a straightforward process of getting rid of pollutants than finding frameworks in which they can be observed, contained, and at least acknowledged to be set within certain limits defined by the massive amount of data and consideration by different institutions, health bodies, etc. In this way, data plays a part in this security operation.

This data-security arrangement leads to the production of a sustainability of the city that circuits the city dweller as part of a bigger, often corporate network of computational events that still does not automatically enable a wider sort of participation in the bigger logic of fundamental political questions. The infrastructures of sustainability are at the moment being touted and built by the major corporations involved in cloud and smart city projects. The computational platforms are at the same time the connection to the corporate platforms of the likes of Google, already piloting and prepared for reception of data through interoperability with Hadoop systems. The Google cloud platform has the processing capacity suited for smog and air pollution data. The environmental and chemical issues become big data: 'Networked sensor technology is in the early stages of revolutionizing business logistics, city planning, and consumer products' (Google Cloud Platform Blog, 2013) – this is the testimonial one-liner that narrativises something which otherwise stays as data: Google becoming the software backend for the big data gathered from client devices observing the city.

In terms of the political questions of this smart city, some of the issues relate to the designs and debates concerning citizen sensing. Here, the sensor is taken as the bottleneck where the major dilemma surrounding the control of data can be addressed on a collective activist level. From the perspective of big data this is more of a modest approach, but useful in activating the question of design, infrastructure, data, and the polluted urban environment. With a focus on the sensors, the issue becomes a stronger articulation of citizen-mapped location instead of mere talk of ubiquity. Much of this design discourse revolves around the value of empowerment and suggests shifting the focus of design from the product to the collective production of sensor placement that becomes a mode for tagging the city according to possibilities of gathering data. It is referred to in terms of 'making things public', in Latour and Weibel's (2005) sense of the term stemming from their jointly curated exhibition. And it partly extends to participatory design where the city becomes reinvestigated through citizen activities.

Gabrys opts for the term 'ambividuals' to situate subjectivity in the smart-sensored feedback city: citizen-subjects function as 'ambient and malleable urban operators that are expressions of computer environments' (2014: 42-43). This is a mode of subjectivity relevant to discussions of cognitive capitalism as a framing of communicative opportunities. But, argues Gabrys, it does not assume the ambividual to be an 'expression of a cognitive subject'; instead it 'does articulate the distribution of nodes of action within the

smart city' (Gabrys, 2014: 42-43). The cognitive becomes a distributed, infrastructural operation within the circuit. It feeds both towards the understanding of the subject and also towards the issues of how the city itself is framed as a milieu, an environment of multiple layers. What Gabrys' (2016) work points out then is the circulation of sensor data as something that reframes not only the question of the city as programmable but also the relation of such programs to issues of citizenship.

In a way, some projects in HCI design demonstrate that the fallacy of the ubiquitous relates to a fantasy of removed, corporate and indeed, homogeneously ubiquitous sensing and processing environment, whereas many of the more interesting projects remind us that this ubiquity is not evenly distributed but becomes an issue that needs further focus: some places are more intensively mapped as part of the ubiquitous than others, some places are more sensed than others (see for example Kuznetsov et al., 2011; DiSalvo et al. 2014). Design projects that, for example, mobilise sensor placement and citizen drones scale down the massive level of computational ubiquity to the question of where the data for the ubiquitous city come from – a point raised in a way by Bratton and Jeremijenko (2008) in another context debating information visualisation, the interface, and different sensor projects.

The data transactions are part of a complex environmental, ecological and territorial operation of defining the secure limits and optimised feedback loops. It is in this milieu that the existing levels of, for example, air pollution are measured. But the data milieu is also conditioned by the historical levels of the layers of the city: its transportation system, infrastructures, the seemingly residual industrial that features as smog. The archaic persists. And it taps into the politically important activities of citizens, who often have to negotiate their work in relation to corporate hardware too, such as Intel-provided cheap sensors. In more philosophical terms, Gabrys (2012) notes that sensorial environments are less about remote sensing of things *out there*, but about capturing them as part of a shared circuit in which they become part of the experience and consideration of 'us'; it is a sort of co-emergent tuning, to continue paraphrasing Gabrys' words, that is not only about a constant processing of sensor data, but also a way of creating matters of concern.

Turning the idea of remote sensing on its head, Gabrys is able to pinpoint a moment where instead of transporting data about the environment to us, such mechanisms function as ways of constituting subjectivity and circuiting us as part of the concerns raised by them. This is where the added layers of sensors, data and their computation are not merely an isolated event of registering. Instead the urban subjects also become functions of that further level of smart computational city infrastructure. This is not a revelation per se, but something that some test cases (such as Santander) and researchers recognise: a lot of the work of sensor data is focused on how 'to improve the performance of key infrastructure, such as roads, rail, water systems and electrical grids' (Newcombe, 2014). Or as Townsend puts it, explicating the situation where infrastructural optimisation becomes itself dependent on the sensitive-added layer of computationality: 'You’re creating a structure that is inherently unstable and can only be controlled by a computer and software that can sense what’s going on' (in Newcombe, 2014).

But the political stakes are not necessarily merely about circulation of information. Instead, it involves a relation to designing infrastructures in which sensing and sensation become possible. Hence questions about sensing emerge as a way to negotiate the techno-bodies of sensation (Gabrys, 2012, referring to Rosi Braidotti) as multiple scales of mediated registering: the human-sensorially and remote-sensorially experienced pollution levels are one such sort of entangled mixed ecology of sensing and sensation. This

point actually comes back to the conceptual development I offered in the previous section through art projects and the relations of the experiential body to the realities of pollution that are not always easily available to the human senses. Hence, Gabrys and Braidotti provide exciting ways to consider this extended understanding of sensors (the technological, the embodied) and the media realities of air pollution as data, as visual screens, as even as taste in Pratt's work.

Of course, this mix can be addressed through informational contexts too but sensors and remote sensing should be understood also in terms of their concrete locations as part of the habitual life patterns of urban dwellers. Sensor placement becomes a tool to hotspot places, to enact a sense of location and movement that engages with the trail of data production. It is at certain spots and in certain activities where ubiquitous cities are being produced. In a way, sensors prescribe certain spots as places of special interest and the placing of sensors then becomes a crucial question as to *where* the city is sensed, *where* it is mapped, and what is being seen as valuable of a tactical or strategic *location*. Barreneche (2012) demonstrates how geo-services produce a specific geographical ontology that is prescribed by way of the software and the corporate platforms through tagging, and the circuiting of user data and so forth. In similar ways we need to see how air and geography are linked through the sensorial, and what prescribes the chemical trails to be turned into visible data as part of the smart city.

Many of these questions raise the issue of what sort of sustainability is being sought, and in what sort of political economic infrastructures. Could we address this by way of different conceptual and even imaginary, design fiction coordinates? Bruce Sterling's (2013) short design fiction about the smart urban megalopolis circa 2050 draws a brief image of the multiple contexts in which the city already lives: the relation to political economic distribution of income and the architectural projects of the financial elite, population growth and the ageing population, a continuing depletion of resources, the changing climate that might have gotten rid of urban smog, but not the 'reek' that is the after-effect of the polluted zones of urban settlements. [8]

Whether imaginaries or real infrastructures, in the context of sustainability we are indeed forced to ask some interesting questions. What are the methods, sites and also conceptual questions – whether design, art or politics – that are able to frame air pollution in the developing context of technological solutions to the city? What are the sites and situations where smog meets bodies meets sensors meets the revelation as to the modes of production of data about the environment? The smog that one can poetically say to be the true visual media arts of modernity – from coal smog (see Mirzoeff, 2014) to the light media of photochemical smog – is seen, tasted, and received in multiple ways that are supposedly 'democratic' but in actuality uneven. Amy Balkin's *Public Smog* project is a demonstration of the complex ties between emission markets, the atmosphere as commons, the legalities of what and where the public is, and the questions of breathability as one about data, but it is also about *financial* data/transactions. Air has a location, and *polluted* air has a location whether or not that lends itself to immediate perception; it is part of urban life of global metropolises and yet also in different altitudes of the atmosphere; not always within the reach of human senses, even if locatable. Also air, the visualisation of air, and sensor operations as well as narratives about air (pollution) are part of the larger question about 'discriminatory distribution of environmental visibility', to use Rob Nixon's (2011: 65) words.

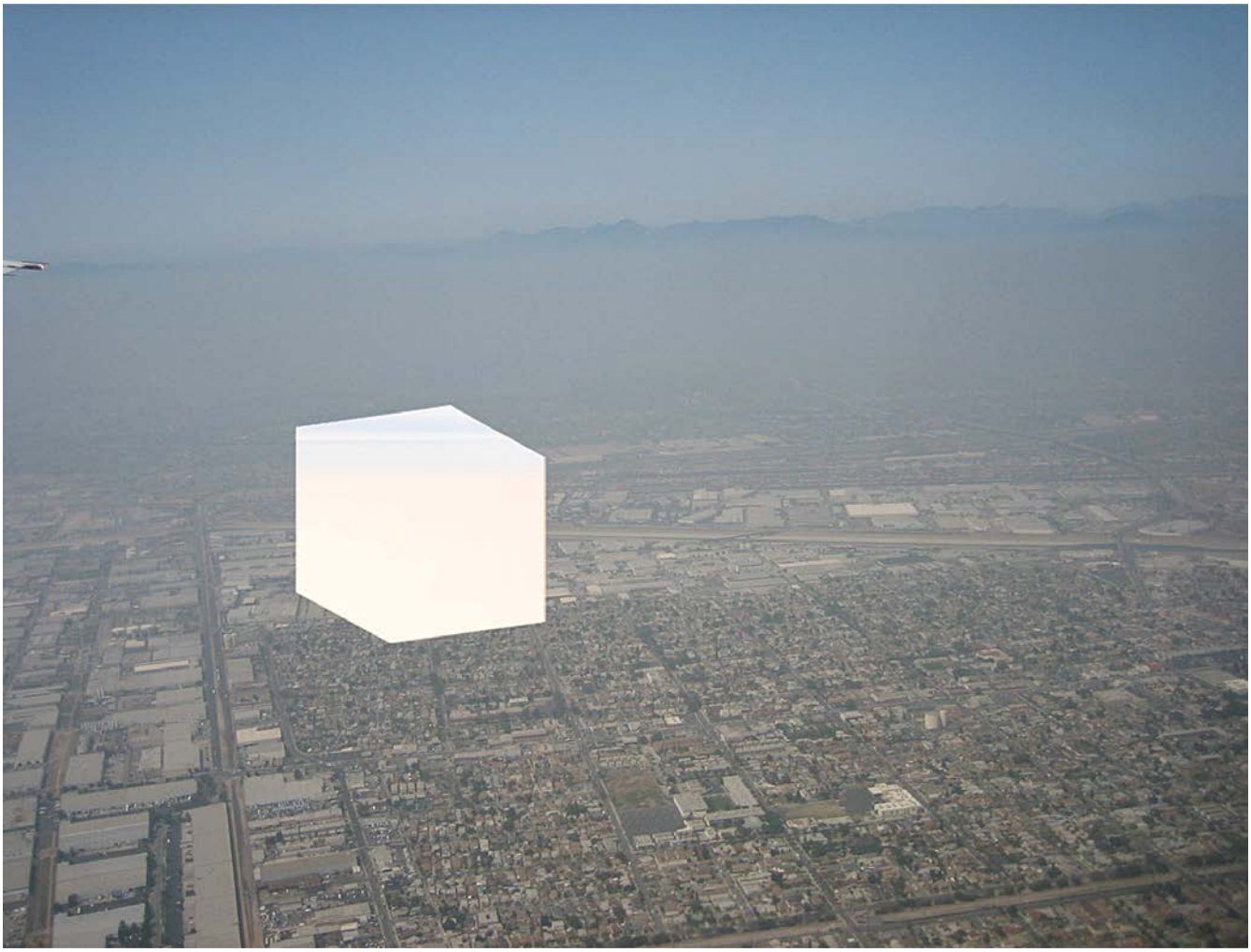

Figure 3. Public Smog, Public Smog over Los Angeles (2004-ongoing). Public Smog first opened during the 2004 summer smog season over California's South Coast Air Quality Management District, which includes urban Los Angeles and Orange County. Amy Balkin, Public Smog. Used with permission.

The issue of location is one central part of the debate and becomes emphasised when focusing on issues of sensation; what are the locations of air and pollution, and how do they become part of the way in which the city lends itself to human *and* technological senses? Moving down to earth from locations above human heads in the atmosphere, air pollution levels also fluctuate radically *within* cities (see Xie, 2014). These differences in locations and their air quality are part of the historical and political ways in which aesthetics is being allocated: the visuals, smells, chemicals and toxins of the city that do not fall evenly. This is the aspect of the *nomos* (Schmitt, 2006) that is not merely a cut in the division of the terrestrial or the aquatic, but also the air. [9] It is not only an ordering of ownerships but also the consequences of urban planning, industrial residue, and infrastructures from transport to the emerging smart cities that themselves are built on top of cities real and imagined, technological and polluted.

Biographical Note

Professor Jussi Parikka is a Finnish media theorist who works at the Winchester School of Art, University of Southampton. Parikka's work has focused on media archaeology, network culture and contemporary media arts. His recent books include *A Geology of Media* (2015) and *Writing and Unwriting (Media) Art History: Erkki Kurenniemi in 2048* (2015, with Joasia Krysa).

Notes

[1] Thank you to Yigit Soncul for his notes on this issue, based on his ongoing (PhD) research project on the mask and modern media ecology.

[2] An important context for this proposition is inspired by Jennifer Gabrys' work, while also relating to my project *A Geology of Media* (Parikka, 2015), which outlines ways in which media theory participates in discussions of ecology and the environmental humanities. Thinking chemical and elemental issues in the context of media culture and media theory is also a way of continuing what John Durham Peters sets out to do in his *The Marvelous Clouds* (2015) by way of investigating how environmental elements can be considered media and how media technologies participate in how we have expanded our understanding of what the environment might encompass. 'Media are civilizational ordering devices' (Peters, 2015: 5), and in this sense, the ordering of our urban environment is an issue of both aesthetic and media consideration – how the environment of air organises our sense of the city, and how technological remote sensing participates in this ordering of the city for us, and sometimes in activist practices.

[3] This aesthetics of and in the city addresses not merely any local condition but issues of global politics. In Nicholas Mirzoeff's (2014) recent take, it becomes entangled as part of the logic of global political movements such as Occupy, which demand a 'right to look' in an exchange without surplus value. For Mirzoeff (2014: 214), this right is 'aesthetically a priori, philosophically foundational, and historically prior' to a gathering of the common moment; but as I would want to argue, it also picks upon the environmentally produced democratic bads as its engine of political manifestation, for example environmental protests suppressed by denial of air (tear gas).

[4] Public Smog-project website, see http://www.publicsmog.org/

[5] On the topic of the public in environmentalism debates and activism, see Luke (2005).

[6] See Citizen Science-project, http://www.citizenscienceks.org

[7] Benjamin Bratton (2016) in his key work on *The Stack* of contemporary geopolitics has already identified the city as one of six key layers in the on-going reorganising of the relations that include much more than just the earth. Discussing cities, Bratton reminds of political subjectivity becoming tied to infrastructural determinations that are much beyond the usual sphere of roads, buildings and plumbing. Indeed, Bratton notes that megaurbanism tells a story of the new interfaces that connect cities to other scales of the planetary systems; a connection through hardware and software stacks.

[8] Sterling (2013) writes: 'There's no urban smog, but the city reeks. This dense, greenhouse stink is composed of the rot from flood damage, the decay of dead lawn and parks, and bursting, sneezy clouds of weedy pollen from invasive species. At the seashores, the great, flood-stricken port cities of the past smell like dead fish and invasive brine. This fetid greenhouse fever doesn't smell much worse than the urban smog that brought it into being. People are used to it.'

[9] Quoting Schmitt (2006: 49): '... because it is not inconsequential whether the industrialized and mechanized world that men have created with the help of technology has a terrestrial or maritime foundation. But today, it is conceivable that the air will envelop the sea and perhaps even the earth, and

that men will transform their planet into a combination of produce warehouse and aircraft carrier. Then, new amity lines will be drawn, beyond which atomic and hydrogen bombs will fall.'

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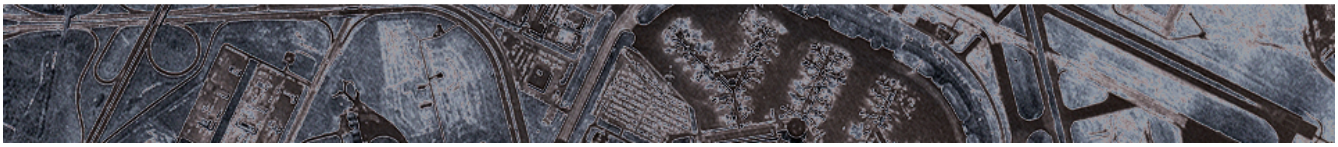

FCJ-220 Imperial Infrastructures and Asia beyond Asia: Data Centres, State Formation and the Territoriality of Logistical Media

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Abstract: This article examines the growth over the past decade in the construction of data centres in the Asian region. Also known as colocation centres or server farms, data centres integrate society with an economy whose technical infrastructure is defined by storage, processing and transmission. Less focussed on the scale of the computational city, the territoriality of data is such that in terms of technical operations, labour performance and the materiality of data the locational specificity of 'Asia' is brought into question. Moreover, the capacity of data centres to operate as sovereign entities external to or in conjunction with the state can be understood as a form of infrastructural imperialism. A focus on infrastructure as it bears upon the composition and territorial scope of the state unshackles state formation from classical varieties of political thought and social imaginaries that assume territory and state as tied to the geographic borders of the nation. The article considers the implications of thinking Asia through the infrastructure of data centres, arguing that the territoriality of data contests the territory of sovereign states in Asia and beyond.

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How do the technical operations and infrastructural properties of data centres produce new territorial configurations that depart from and challenge the territorial borders of the nation-state? And what is distinct about such formations within the Asian region? These are the core questions that guide my thinking on digital infrastructures as a novel instantiation of imperial power. This is a power not beholden to the logic of the sovereign state, though it may take on attributes of the state such as the authority to decide and the power to govern economy and space, society and culture. It is a power that may also overlap with policy making and the ideological contours of the state. [1] And while such power may manifest chiefly in metropolitan, urban settings, its computational dimensions lend it an elasticity not reducible to the scale of cities. The pursuit of public-private partnerships, taxation incentives to attract foreign investment, a ready supply of technical expertise and low wage agreements for service labour, relatively stable political systems and generous land concessions are some of the typical arrangements that feature over the past thirty years or so that has seen the conjunction of state and firm in ways frequently

aligned with neoliberal governance and economy. To make such associations is also to acknowledge the intersection of ubiquitous media with labour, life and a broad range of economic transactions driven by the transmission of data. Accompanying the transmission of data are hardware operations of processing and storage, all of which take us to the data centre as a key infrastructural site in the spatial and temporal organisation of world economies and routines of daily life.

The data centre can be considered imperial insofar as it commands a power to connect agencies and their economic interests in ways that stretch across the territory of cities, nation-states and continents. As a region undergoing rapid expansion in the business of constructing data centres, Asia is positioning itself within a new geopolitical and economic constellation endowed with a capacity to govern and control global data economies and financial transactions on planetary and, indeed, extra-planetary scales. Satellite communication and space exploration also require the facility of the data centre. The interoperability between data transmissions and transactions occurs in tandem with technical specifications and information architectures related to Internet protocols, storage media, cable infrastructure, database systems and hardware design. Also relevant are juridical frameworks specific to the regulatory regimes of nation-states and commercial trade agreements.

However, when speaking of the territoriality of data centres it is inaccurate to invoke the idea of Asia as a region in as much as the geocultural and geopolitical borders that comprise a regional space contained by cultural and political imaginaries along with various political-economic organisations and trade-driven agreements (e.g. ASEAN, SAPTA, FTAAP) do not map neatly on to the infrastructural space of data centres whose locations happen to be within Asia. Depending on operational requirements, contractual conditions and commercial interests, the provenance of data may be territorially distinct at sovereign, geopolitical levels from the location of its storage. More specifically, then, the Asia of data storage, transmission and processing facilities consists in part of a string of locations within cities and countries that, while geopolitically belonging to the Asian region, are spatially tied through political economy and protocological interoperability to similar facilities distributed across the world.

The refrain of this article asks what is special about communications infrastructure such as data centres that lends itself to a territorial propensity? And can this tendency be considered a form of infrastructural imperialism beyond or autonomous from both the state and corporation? Moreover, does territory precede infrastructure – the planet as substrate to the propensity of cables – or does infrastructure produce the world as territory? As John Durham Peters deduces, 'infrastructural media are media that stand under' (2015: 33). If technological properties are ontologically prior to the state and corporation, questions of state formation and global economy can be approached from the perspective of logistical media and the infrastructure of its operations. But they do not sit in isolation from the environments with which they are enmeshed. Logistical media are activated as orientation systems in the instance of the arrangement between software, infrastructure and labour. The article examines how the territoriality of power manifests through communications infrastructure such as data centres to produce a new sovereign entity that I term *the logistical state*.

In sum, then, I will proceed with the following hypothesis: territoriality consists of operational practices specific to infrastructural systems and technical devices, the effect of which produce territory as spatial arrangements and temporal dynamics that may contest or conflict with state-based claims to control over the bounded space of the nation and its sovereign extensions. I consider the implications for conceiving

Asia as a geocultural and geopolitical formation by focusing on the territory and territoriality of state formation wrought by imperial infrastructures of logistical media.

The Territory and Territoriality of Power

One of the key yet little commented on Snowden revelations in 2013 of the United States' National Security Agency's (NSA) PRISM program is that it inaugurated a new regime of territorial power based upon the aggregation and analysis of data in real-time. Territory is understood here as spatial and temporal regimes specific to the operation of data. Territory is thus not limited or reducible to the geographic and political borders of the nation-state. The geoeconomic and geopolitical transformation of spatial calculation is, as Deborah Cowen argues, central to 'the work of logistics [which] is concerned precisely with the production of space beyond territory' (2014: 51). Framed within a technics of territory, the Snowden revelations also suggest a new kind of empire and machinic imperialism in terms of the use of communications infrastructure for data sharing and surveillance as systems of logistical control. As Internet entrepreneur Kim Dotcom (2013) notes, the 'Five Eyes Alliance' between intelligence agencies in the U.S., Canada, Australia, New Zealand and the U.K. 'effectively permits those governments to circumvent the prohibition against gathering data on their own citizens by sharing information across the Five Eyes intelligence community'. The data and information shared on a NSA operated spy cloud shows how these intelligence agencies are working together to overcome legal and geographic limitations of the nation in their own state-based democratic contexts. Along with the tech companies in collusion with NSA (Facebook, Google, Microsoft, Yahoo, Apple and Dropbox), we can assume other aligned countries might act or be acting already in similar ways. The capacity of the PRISM program to exploit vulnerabilities in real-time at the level of communication links between data centres further extends a general definition of logistical media. Moreover, it points us in the direction of communications infrastructure as it relates to the production of territory.

For centuries territory has been synonymous with the contest of power. Conventionally understood as a bounded space of varying scales, Stuart Elden, in his book *The Birth of Territory*, argues for a more critical appraisal of territory as it bears upon the authority of the state. Elden proposes an investigation of historical dimensions and conditions of possibility not typically featuring in studies of the state as a 'bordered power-container' (Giddens, quoted in Elden, 2013: 3). But as Elden notes of John Agnew's identification of the 'territorial trap', the spatiality of power need not be reduced to the territory of the state. The territory of data centres includes not just the geography of cables that span its operations; it might also be understood in a more diagrammatic sense as consisting of elements or entities and their capacities brought into relation. Such a notion of territory also suggests a more flexible comprehension of time and space that can be termed *territoriality*. One could inquire, for example, not only into the temporality of low-latency networks special to high frequency trading, but also into the labour regimes that construct data centres, assemble its hardware, undertake technical maintenance and administer platform operations. The temporal rhythm and spatial circumstance of each of these jobs is not independent of the spatial configuration and temporal propensity of data centres. The 24/7 maintenance of servers, for instance, may combine onsite technicians with remote network operators residing in different time zones.

Such examples illustrate the ways in which the territory and territoriality of data centres is both enabled and defined by multiple spatial layers in conjunction with variable circuits of time. Part of the scalar dimension of data centres is not territorial in the geographic sense but is rather derived from amassing

colossal amounts of data that enable the centralisation of analytic and economic power. 'For the data-driven world', as Gary Hall (2015) notes, 'is one in which the data *centre* dominates'. While there is design variation in how data centres are constructed from one site to the next, this doesn't mean that power doesn't concentrate. If climatic considerations were the only determining factor in deciding where to locate data centres then countries like Iceland and Norway and not Hong Kong and Singapore would index the geopolitics of data. Data exchange coupled with standardisation creates concentrations of power, thus firms colocate within particular facilities. [2] The capacity of data centres to operate as sovereign entities instantiates infrastructural imperialism in the form of logistical empires.

There is thus both a territory and territoriality to logistical media and infrastructural power from which geopolitical implications and media-theoretical propositions emerge. As a political technology of containment, logistical media produce new forms of territory that govern the movement and economy of data tied to labour, finance and things. Territoriality, by contrast, consists of the production of space and time beyond the constraints of bounded space specific to the borders of the nation-state. The movement of data, operation of software and design of infrastructure is enforced through juridical regimes that encode the territoriality of logistical media with legal protocols bringing logistical operations in relation to institutional settings of both state and suprastate legal apparatuses. [3] The policy, technical and legal architecture of intellectual property regimes (copyright, patents, trademarks) generates economy, culture and even subjectivity underscored by multiple fronts of dispute within geopolitical and geocultural spaces of connection and disconnection.

Territoriality, in other words, involves the work of producing complex arrangements and systems of transmission and exchange that operate on both spatial scales and temporal horizons. Importantly, territoriality also consists of spatio-temporal practices not reducible to the sovereign authority of states. An example of this consists of forms of territoriality produced through reappropriating infrastructural technologies such as radio telescopes, which in the case of experiments such as radioqualia and Acoustic.Space.Lab foreground how infrastructures of communication forge sonic geographies generated from the acoustic soundwaves retrieved from outer space. [4] Elden suggests that rather than understanding territoriality as 'the condition or status of territory', it can also be analysed as 'a mode of operating toward that territory' (2013: 4). If territoriality is about operational practices that stem from and, in turn, produce territory as new spatialities, then logistical media provide an empirico-analyical device that give insight into such processes.

Understanding media in such a way involves a shift away from an ontological concept of technology that focuses exclusively on technical properties as the drivers of change and instead casts such considerations within a broader constellation of processes that include cultural practices, epistemic objects and institutional routines (see Horn, 2008). The geotechnical arrangements of infrastructural imperialism in an age of fibre optic cables, data centres and low-latency computing lend logistical media its pervasive quality. Such infrastructure not only conditions the possibility of a logistical world gone awry, its technical properties are coupled with a computational force and political economy of data analytics and integrated technologies that saturate every surface and substrate of organic life and inorganic matter (see Hörl, 2015).

When communications infrastructure is not synonymous with the state, nor even exclusive to the private sector (since throughout the history of communication technologies there are frequent examples of public-private partnerships to fund the construction of infrastructure), we might shift the unit of analysis from

political or commercial form – which is an analysis of institutional apparatuses and political economy – and instead focus on what Keller Easterling (2014) calls the disposition or propensity of infrastructure space and what medium theorists tend to call the properties of technological forms. [5] This becomes a question of ontology derived from the activity of organisation. Daniel Gethmann and Florian Sprenger frame this nicely with regard to telegraphic cables: 'The cable supplies the world with an idea of its connectivity'. [6] Here, the ontological dimension of cable infrastructure is integrated with or immanent to its substrate, the territoriality of the planet. Arguably, the ontology of cable at both material and conceptual levels conditions the possibility for the world to know itself through relations. The move from technological propensity to planetary knowledge registers the difficulty of teasing out the distinction between ontology and epistemology.

In 'exposing the evidence of the infrastructural operating system' (Easterling, 2014: 21), we can also speculate on the ruins of infrastructure. Whether it is decommissioned cables and data centres made obsolete, or earlier communications infrastructure such as destroyed satellite antennae, or even the hacking of algorithmic architectures that orchestrate the financial transactions of high frequency trading, the infrastructures of power are surpassed by the march of history. Like the general critique of infrastructure, such a view shares something with Jussi Parikka's summary of the legacy of twentieth century philosophical thought: 'only once things fail, *then* you start to see their complexity' (2015: 98). This is also an axiom at the core of cybernetic systems that are engineered as logistical media. To think of the ruins of logistical infrastructure is a form of immanent critique. This is particularly the case with artistic practices that collectively repurpose infrastructure for projects never programmed into the blueprints of their initial conception.

The question of how knowledge is organised and, subsequently, how labour is managed is also part of this story. In developing a critique of data-driven capitalism, what can we learn from the ways in which knowledge is produced and organised within a technical apparatus? How central is infrastructure to such developments and how might the ruins of a logistical future be reappropriated from the slumber of disregard as a resource with which to imagine and practice counter-systems that are not beholden to technologies of capture that define the current conjuncture? First, it is necessary to establish how infrastructures of communication as technologies of power are involved in the production and organisation of territory. In foregrounding the relation between infrastructure and organisation, the case of data centres provides another point of entry into the production of technical knowledge as a foundation of infrastructural power. As the Invisible Committee observe in their analysis of political insurrection and logistics, '*power no longer resides in the institutions… power now resides in the infrastructures of this world*' (2015: 82-83).

Logistical Media and the Situation of Data

In probing the question of logistical media – of the political geography of infrastructures and the material force of their situation – we might ask where the data centres are located and whether this has any bearing on the design of business imaginaries of cloud-based economies. The static mass of data centres is lodged in dirt and concrete and seemingly without an object of acceleration required to meet Newton's second law of motion. There would seem, therefore, to be no obvious material force generated from their situation. Yet the speed with which data moves along the cables extending from data centres across oceanic and continental territories does, by contrast, rely on post-Newtonian and non-mechanical physics. Herein lies

the paradoxical force of the situation of data centres: they are static in terms of infrastructural location, but at the operational level they are mobile in terms of the acceleration and transmission of data.

At another register, the situation here also refers both to the setting within which we find ourselves, and the predicament that attends such placement. This is the force of determination. It offers a refuge for those in need of identity (and allocates one to you whether you like it or not), and it imposes terrible constraints upon our desire for freedom. But as Stefan Heidenreich astutely observes, 'Materiality of media does not need to consist in solid objects only. *Whatever transfers a force through space or time should be considered*' (2015: 140; my emphasis). As is so often the case with data centres and cloud computing, 'The fundamental material layer often goes unnoticed, even though it sets some basic conditions for all communication based upon it'. For Heidenreich, critical attention should be turned toward the impact of standards and protocols and the ways in which they 'enforce material-independent constraints' (2015: 14). This takes us to the politics and economy of enterprise software systems. But it also allows us to think of how data centres exert change and transformation upon economies through the velocity of data as a result of their processing operations and the materiality of cables. And perhaps also the more immaterial force they exert through their material presence as perceptible objects prompting responses to issues of security, surrounding economies, labouring subjectivities and so forth.

Indeed, what sort of data traffics through different data centres distributed in strategic locations throughout the world? Are there juridical regimes specific to different types of data? How is the provenance of data complicated in legal ways by the location of its storage? What sort of protocols of hardware and storage are required for, say, financial data as distinct from the data collected by the state or military apparatus, or produced from what Soenke Zehle (2012) terms the 'logistical lifestreams' that define our social media worlds? And to what extent do the technical operations, geography of location and political economy specific to different data centres determine the types of businesses and organisational practices dependent on hosting services? These are questions that also go some way toward designing a media theory of data centres, which are a key communications infrastructure for the logistical processes of contemporary capitalism and global supply chains. But there are no definitive one-size-fits-all answers here. Sometimes *difference makes a difference* (see Bateson, 1972). And sometimes it doesn't.

The data centre as communications infrastructure extends from bricks-and-mortar of the building, the specific cabling, monitoring, security and fire safety mechanisms of its internal operations, the training regimes (e.g. Cisco networking certification) required of its human operators, the kinds of specific computing devices engineered to optimise rack space and save costs (e.g. 1RU servers), the 'hardened' software operating systems (usually Linux or other UNIX variants), the software utilities used to monitor, route, load balance and optimise bandwidth and network traffic, the algorithms that ensure security, redundancy and optimisation in the writing of data to disc – the list could go on. Many of these are necessarily standardised and the pathways from military to financial to broader commercial application and back again are often complex, circuitous and seemingly ad hoc (but for the strong geographic concentrations of these various industries in parts of the U.S. and elsewhere). A media theory of data centres would, therefore, need to accommodate the apparently paradoxical situation of both differentiation (by technical operation, geography and political economy) and standardisation. [7]

The Traffic of Data

Frequently hidden from view until it breaks down, the geography of communications infrastructure that drives global economies also defines new territories of power. As Matthew Tiesen (2012) explains in his account of high-frequency trading (HFT) and the spaces of finance capital, 'In light of HFT's appetite for unlimited speeds and unlimited financial-arbitrage opportunities, the central nodes of the global finance network – London, New York, Chicago, Tokyo, etc. – are becoming its peripheries insofar as these days it's the spaces in between the exchanges where the real action occurs – or has the potential to occur'. And as Michael Lewis (2014) makes clear in *Flash Boys: A Wall Street Revolt* (a book whose peculiar genre fuses straightforward reporting with the anxious pace of a conspiratorial thriller), the relation between the geography of fibre optic cable and algorithmic capitalism is determinate in the economy of high-frequency trading. The 'co-location' of exchange servers with the computers of high-frequency trading firms function to minimise the journey of data, resulting in a form of insider trading that always outpace the efforts of brokers, hedge-fund managers and ordinary traders. While there is nothing especially new about the impact of finance driven capitalism on labour – Rudolf Hilferding, John Hobson and later Vladimir Lenin identified how over a century ago the structural force of financialisation and imperialism is the basis of 'organised capitalism' – I would nonetheless suggest that data centres register an intensification of such processes. Bringing critical attention to the coupling of algorithmic capitalism with data centres instantiates a materiality that helps demystify the abstraction often associated with processes of capital accumulation. Although such a move also invites further mystification: how to study the inaccessibility of data centres as an infrastructural object? And how to even begin analysing the algorithmic architectures specific to HFT and other computational operations of capital?

Vincent Mosco (2014: 71-72) notes that 40 percent of data centres are located in the United States, with Scandinavian countries and Canada attractive options due to their cool climate and abundance of water supplies, which along with 'their bandwidth Internet connections, political stability and financial incentives' are key to offsetting energy costs associated with air-conditioning (Mosco 2014: 36). Yet the growth over the past ten years or so in the construction of data centres around the world, particularly within the Asian region, signals an historic and paradigmatic shift from the extraction of surplus value from labour as a core structural dynamic of the capitalist mode of production to an arguably novel form of surplus data within an economy of algorithmic capitalism that at first appears less dependent on the subject of labour. This is especially the case with high frequency trading, where the nano-speed of trade operates beyond the threshold of perception and with minimal human oversight or intervention.

The once strategic function of telegraphic cable landing stations are no longer necessary with the introduction of new technical forms of networked communication such as fibre optic cables. The technical realisation that particular infrastructural forms of networked communication are not sustainable is registered in the shift from telegraphic cable stations as relay nodes to point of presence beyond the station. Cable stations, in other words, are no longer essential infrastructural nodes for accessing fibre optic signals. The technical development of undersea branching units in effect shifts the cable station offshore, resulting in what Nicole Starosielski (2015: 124) terms new models of dispersion for signal traffic. The eventual obsolescence of infrastructure is something we should be attuned to for the possibilities of reoccupation and experimental reengineering.

From this geotechnical perspective, then, infrastructure complicates the passage of state formation and

may privilege empire as the organisation of power on the basis of both technical propensities and economic interests. The point at which undersea cables make contact with shore at cable stations becomes a form of imperial occupation. As Starosielski maintains, 'The cable station became the critical geopolitical node for all transoceanic traffic: it was a cable colony intended to be self-sufficient and culturally insular, autonomous from its surrounding geography' (2015: 111). For Starosielski, the telegraphic cable station of the nineteenth century was not shrouded in anything like the secrecy that surrounds the cable stations that support the landing of oceanic fibre optic cables. So it is not cables *per se* that prompt a secrecy of operations as much as the commercial interests and political agendas that increasingly populate the twentieth century across a range of media forms, including telephony, broadcast media and satellite communications (see Schiller, 2011).

In the case of cable landing stations as they relate to data centres, a geography of proximity prevails between these two infrastructural forms in the interest of maximising low-latency networks able to service economies of speed required for a range of sectors, especially those in finance and high frequency trading. These are heavily securitised spaces whose labour regimes are at once localised and frequently gendered with male technicians servicing the severs, while remote workers engage in the drudgery of chores such as data entry and the like on the part of clients whose operations may be based anywhere in the world. The more high-end of corporate IT labour is not immune from the shifting geographies of data centres. As Mosco points out, when a company puts its servers in a data centre or goes down the path of software-as-a-service, it is often enough the case that the IT department is closed, leaving corporate IT labour swimming in search of another job – which may mean abandoning the sector and retraining or joining the ranks of the unemployed (see Mosco, 2014: 163-167). But such impacts on labour by technological developments and political economic practices are not a foregone conclusion. The widely projected unemployment trends forecast by various iterations of outsourcing and automation have often been defied by counter-trends within the sector. A more obvious case is the need for endless reskilling and insecurity implied by technological churn – server administrators become corporate IT strategists, IT support staff become trainers and teachers and so forth.

The Geography of Data Centres

In updating the question of infrastructure and the constitution of the state as a multifarious complex of actors overseeing the management of people, finance and things, we might specifically address the structural force and operational capacity of data centres. Certainly there has long been a crucial labour cost related to questions of infrastructure and geography, as we can note in the protracted struggle by German labour union ver.di in its demands for better working conditions in Amazon's warehouses. Infrastructure, it turns out, can itself be highly mobile, flexible and able to be relocated for legal and political reasons. Indeed, politics is entirely relevant to the strategic decisions around the geography of investment related to data centres. As one consultant on IT infrastructure in the Asia Pacific advises, 'most countries in Asia are lucrative markets to set up and grow businesses, barring a few which have political and technological environments as deterrent factors' (IDC, 2014). But politics here usually consists of more force when it is wielded by the sovereign power of the state rather than labour unions. Google's exit from Beijing in 2010 was frequently reported as an act of Western corporate defiance and social justice against China's insistence on censoring search engine results, but it was nonetheless a submission to sovereign control and a humiliating retreat from the centre of contemporary capitalism. And of course there's also a business reality to Google's decision to quit China. As one report in *Forbes* magazine noted in 2010 following the

withdrawal of Google, the more innovative local search engine Baidu 'only increased its market share, going from 47% in mid-2006 to 64% today' (Fannin, 2010).

Over the past few years Taiwan, Hong Kong and Singapore have become strategic sites for investment in storage facilities for cloud computing. Companies like Google have built data centres in Taiwan and Singapore to accommodate the rapid growth of Internet users across the Asian region. As reported in *PCWorld*,

> While the Taiwan data center is on 15 hectares of land [in central Taiwan], the Singapore data center in Jurong West is built on a smaller area of close to 2.5 hectares. It is designed as Google's first urban, multi-story data center, and is in the neighborhood of a local primary school and publicly-run housing. (Ribeiro, 2013)

Local authorities are keen to attract such business, which they expect will produce a range of spin-off benefits for local firms. As Google Taiwan's managing director Chien Lee-feng remarked in 2012 following the announcement of the USD $300 million Google facility in September 2011 (with USD $700 million slated for long-term investment in the region), 'We anticipate this data center will evolve into a [cloud-computing technology] hub and will create a supply chain here in Taiwan' (Wang, 2012). By the time of its completion in December 2013, the budget for the Taiwan investment had risen to USD $600 million (see Chiu, 2013). It is hard not to also see the move of Google to Taiwan and investments in Hong Kong as a quasi-subversive repositioning for a re-entry into the People's Republic of China.

The *Taipei Times* goes on to report that 'Google's local suppliers include Quanta Computer Inc (廣達電□), which supplies servers to Google, and Nanya Technology Corp (南亞科技), which supplies memory chips used in servers' (Wang, 2012). Data centres, then, are key components of global logistics industries and reshape the economy of cities in terms of the composition of labour, the integration of manufacturing and service industries, and the formulation of trade and communications policies designed to attract investment. After abandoning plans for the construction of a data centre in Tseung Kwan O Industrial Estate in the New Territories, the two Google data centres in Taiwan and Singapore produce a geography of the cloud that includes the six data centres in the United States along with two in Europe and another opened in Chile in early 2015. One might suppose that the high temperatures in Taiwan's hot summers along with the potential instability of weather associated with its typhoon season might act as a deterrent for infrastructural investment in the country. But it turns out such climatic variations provide a basis for Google to tout its green credentials and innovative design in its 'use of a night-time cooling and thermal energy storage system that cools large quantities of water at night' (*Huffington Post*, 2012). But the issue of electricity consumption required for running data centres is not insignificant. As my colleague Tanya Notley (2014) has noted (along with others researching electronic waste, such as Jennifer Gabrys, Richard Maxwell and Toby Miller), 'Server farms currently use more than 1.5% of the world's total electricity (and rising) with more than half of this energy used in the cooling process'. A public policy study on green energy use for data centres notes that since 2000, 'the overall rate of energy consumption for U.S. data centers, sourced primarily from polluting energy, has grown at an average rate of 14 percent per year' (Kavitz et al., 2009).

A data centre is not necessarily a data centre. Which is to say that the technical and material specifications of data centres depend upon the type of data being hosted. We know that data centres offering low-latency networks are the preferred choice for high frequency trading, which, as Donald MacKenzie (2014: 28) notes,

takes place in around 15 data centres around the world (most of which are located in the U.S. and Europe). But low-latency networks are not an economic priority or technical possibility for all data centre operations, where energy costs related to the cooling of servers are a key factor in the determination of business margins. The specific requirements of data centres built for hosting and mining cryptocurrencies such as Bitcoin offer a clear example of the variation in capacity and function of data centres. Bitcoin currency is generated through the marvels of blockchain processing – 'the distributed ledger that keeps track of all transactions made using the Bitcoin cryptocurrency' (O'Dwyer, 2015). [8]

To effectively mine more Bitcoins from the blockchain requires greater computational power. And this is what purpose built data centres offer. In the days when Bitcoin was riding high, the cost of leasing data centre space wasn't such an issue. But once the plunge had set in around early 2015, alternative facilities were required with server functions more tailored to the different processing needs specific to Bitcoin mining. [9] Early in 2015 BitFury Group, one of the largest companies specialising in high-density hardware used in Bitcoin mining, made a takeover bid for Hong Kong's Allied Control – a start-up known for using immersion cooling in the mining of Bitcoins (see Miller, 2015). This two-phase cooling technique involves removing heat from semi-conductors used for mining Bitcoin transactions with a supposedly non-ozone depleting liquid solution base of fluoroketone developed by 3M (a U.S.-based global firm stemming from Minnesota Mining and Manufacturing Co., founded in 1902), who claim up to 97 percent savings with their Novec Engineering Fluid compared to traditional air-cooling methods. [10] Not requiring the proximity to landing cable connections that make possible low-latency networks in HFT, data centres specialising in Bitcoin mining can therefore broaden the geography of infrastructure as it relates to the construction of data centres. With a data centre in Iceland, BitFury announced in June 2015 that it was acquiring a 185,000 square meter privatised plot of land in the Republic of Georgia to build a mega data centre to host its Bitcoin mining hardware. Along with low energy costs and a competitive labour market, BitFury has partnered with the 'Georgian Co-Investment Fund, a $6 billion private equity investor in companies interested in business opportunities in the country' (Sverdlik, 2015).

Variations in infrastructural requirements begin to indicate a media theory of data centres that decomposes the singular data centre into a typology. Certainly service offerings are significant here, although there is often little differentiation to be found at this level. More significant are the infrastructural capacities of data centres, which can be distinguished at the level of hardware in terms of low-latency to processing power. These sort of factors then impact on decisions over where a data centre is built, its size and whether adjacent land may be valuable to acquire. Think, for instance, of how real-estate in close proximity to data centres supporting high frequency trading may be strategic to purchase in terms of blocking access to potential competitors wishing to make use of low-latency cables. Or, in the case of Bitcoin mining where energy costs associated with processing power and computational cycles are important, a typology of data centres may foreground external factors related to environmental conditions or government authorities able to provide attractive investment packages for the construction of specialised data centres.

A fully developed media theory of data centres would address the operational capacities of data centres on their own terms. Such an undertaking would partly be a study of the technical as a foundation for developing concepts rather than relying exclusively on transposing the washed out buzz from philosophy or political theory to the technical object of research. And it might also be a study in how the ontology of data (to go philosophical) and the materiality of infrastructure have territorial propensities. How, in other

words, do cables, servers, cooling systems, data processing and analytics and the labour of their servicing (when not automated) produce a form of data sovereignty beyond the state? And for an inquiry such as the one of interest to this article, how might a logistical dimension be special to such operations?

Questions such as these point us toward a more general target of critique – the operation and organisation of infrastructural and logistical power. Whether such authority is wielded by corporations or the state is less important than the fact of its existence as a force that is often extremely difficult to identify but is no less present in its effects. The accumulation of infrastructural power is all well and good for clients with an interest in minimising latency for commercial purposes, but how might others not in the business of data services and the pursuit of commerce exploit these infrastructures to support more radical agendas? Can we envisage our own artistic practices or critical research, for instance, as having some use for colocation services? These are not questions that I have ready answers to, so I signal them here as markers for future research. Suffice to say that the artistic practice of producing blueprints of an imaginary future provides one technique of subtraction from infrastructural power and the society of tracking, indexing the obsolescence of control and the rerouting of capture into models of psychogeographic displacement. But before moving to this article's conclusion, it is first necessary to identify the organisation of power coincident with digital infrastructures of capture and coordination.

The Logistical State and Infrastructural Imperialism

How does infrastructure constitute the state? In setting up the foundations for a theory of the state, Max Weber follows Leon D. Trotksy: 'Every state is founded on force'. This classical definition of the state is often translated and interpreted as the state's monopoly on violence and has informed much theorisation of the state throughout the twentieth and twenty-first centuries. [11] Weber makes the important additional qualification that brings population – or what he prefers to term 'community' – and territory into the orbit of state power: 'The state is the human community that, within a defined territory – and the key word here is "territory" – (successfully) claims the *monopoly of legitimate force* for itself' (Weber, 2008: 156; emphasis in original). What might it mean to think the state, territory and population as they intersect with processes of informatisation and, more specifically, the geography of data centres? If territory consists of the organisation of power across spatial scales and technical systems, then what are the implications of infrastructure for a theory of the state? And how might we think the temporal properties special to the optimisation of speed (low-latency) within data centres? Such questions begin to alter the baseline Weberian model of the state that has informed so much theorising of the state, whether in radical or conservative veins. Approaching the question and constitution of the state in such a way involves foregrounding the production of territory through infrastructure – rather than a monopoly on violence or exertion of force – and thus contributes a media-theoretical perspective to scholarship on state formation. A focus on infrastructure as it bears upon the composition and territorial scope of the state unshackles state formation from classical varieties of political thought and social imaginaries that assume territory and state as tied to the geographic borders of the nation. I am not suggesting an infrastructural approach eclipses the extensive and diverse theorisation of the state so much as further complicates the organisational logic of power attributed to the state as an entity of transformation.

If, as Jürgen Osterhammel submits, 'Empires are structures of rule on a large scale' (2015: 424), then what does it mean to approach both politics and the political from within an imperial horizon? Such a proposition invites us to think the work of organisation, the collective design of strategies and tactics of

intervention on planetary scales when empires are made imperial through digital infrastructures of communication. Of course the imperial dimension of empire is not exclusive to digital infrastructures. As Harold Innis's writings on empire and communications attest, experiments in statehood in the form of imperial bureaucracies were facilitated by space-biased media such as papyrus and the time-biased media of parchment (treated animal skins) supporting the maintenance of an ecclesiastical hierarchy in the ancient Byzantine empire (see Heyer, 2003: 50; see also Innis, 1986). Architecture and sculpture also indexed the imperial power of empire within ancient cultures (see Heyer, 2003: 80). Built forms such as the Egyptian pyramids could be witnessed for the symbolic authority they command over time.

By dramatic contrast, the imperial power of data centres is nowhere to be seen. Hidden away in purpose built facilities or retrofitted warehouses, data centres blend into the urban fabric when they are not in secret or very remote locations. As infrastructure of seeming invisibility, their network of cables nonetheless marks out territories of control with computational processes signalling the occupation of time in ways calculable to the interests of capital. One might very reasonably attribute such features, more or less, to the corpus of modern communication technologies since the advent of electronic telegraphy. The abstraction of communication power has indeed defined the epoch of modernity and the time of our time (see Castells, 2009). When situated within such a lineage, data centres may not present as especially novel in their mode of abstraction. Indeed, one can draw various parallels between telegraphy and data centres. But they register an intensification of technical processes and structural tendencies with regard to the exertion of logistical media as a form of infrastructural imperialism.

The situation of data infrastructures holds a substantive force in the making of territoriality. But how might an account of infrastructural power retain a notion of imperialism that is not beholden to the territorial extension of the nation-state? This is not to ignore the constitutive relation between nation-states and large corporations with interests in communications infrastructure. Google's exit from mainland China in 2010 hasn't stopped IBM, Microsoft and Amazon, who are among the largest players in cloud service, taking advantage of China's burgeoning industry in the construction of data centres. Typically, these arrangements involve a suite of government incentives with pledges by the global corporations to support local and regional economies with software and platform services along with support programs, for example, in the form of start-up incubators. But this isn't a one-way street of major players exploiting nation-states to their benefit; as the termination of Google's operations in China made clear, along with the Snowden revelations, companies in the business of communications infrastructure can still be highly vulnerable to the whims of the nation-state.

However, my interest here is a different one. Conflicts in technical standards and protocols that determine how data centres connect and disconnect from each other and associated client networks suggest that spatial conceptions of territory give way to, or at least run in tandem with, the non-spatial territory of technical knowledge and the properties of hardware in conjunction with the temporality of interface design and data transmission. Policy architectures also come into play here. Relevant examples would include the ratification of Internet governance between suprastate institutions and member states of international agreements such as the WTO's Agreement on Trade-Related Aspect of Intellectual Property Rights (TRIPS), or ICANN's management of Internet protocol addresses and Domain Name Systems, which involves input from representatives of the 111 member states comprising the Governmental Advisory Committee.

When multiplied in such ways, territory not only unbundles the coupling of the state and its geographic

borders, it also evades any easy or straightforward analytical capacity to contain an object of investigation and critique. To contain an object within the imaginary of the nation-state is a mistake. Often enough the polis usurps the imaginary of sovereign power commanded by the state. [12] By interrogating infrastructure such as data centres and, as discussed earlier, their prehistory in the form of electric telegraphy, one begins to question 'whether modern communications technology made empires more stable' (Osterhammel, 2015: 425). Counter-systems and methods, Osterhammel reminds us, are present as a disruptive force that test the monopoly of infrastructure presupposed by both state and non-state authorities as quasi-rivals in the territorial control of data. [13]

For Weber, the modern state is defined sociologically 'by reference to a specific *means* that is proper to it' (2008: 156). The state, in other words, involves a capacity – political or otherwise – that is specific to the territory of its operation. Territory, here, is to be distinguished from the sovereign territory of states. The U.S. military, for example, operates beyond U.S. territory. In this regard, the operation determines the territory of the state. And infrastructure, as I have been arguing, provides the structure that makes operations possible. The means proper to the state is the method of the state, its content comprises a technology of governance that belongs to and is the property of the state. Extending far beyond sovereign territories, infrastructures of communication constitute another layer of sovereignty that offer a different analytical rubric when not subsumed under the expansionist agendas of statehood. When cast in such a way, we can begin to translate what is in effect the ontological dimension of the state – the *means proper to it* – in ways that address how infrastructural operations are central to the formation of the *logistical state*. Of relevance here is the political and economic geography and technical operation of data centres. Such considerations might revive a critique of the state based on its support of commercial data centres through financial levers such as attractive corporate tax breaks, generous land leases, flexible labour regulations and free trade zones among other forms of state subsidy funded by national citizenries, not to forget lines of revenue generated by the efforts of non-citizens residing in the territory of the state. To speak of the capacity of the state in these terms is also to conceive of a logistical state.

Communications Technology and the Logisitical State

Within an Innisian framework the 'territorial state' of ancient civilisations and their empires was predisposed toward a spatial or temporal bias as a result of the material properties of prevailing transport systems and communication technologies. [14] And this made them vulnerable to external forces able to exploit such infrastructural oversight or limits to capacity. The logistical state, by contrast, encompasses both of these dimensions simultaneously. The global networks of supply chains expand the territorial reach of producers and suppliers required for the operation of the logistical state. Enterprise resource planning (ERP) software systems calibrate labour productivity and coordinate the movement of goods and finance in real-time and data centres store, process and transmit the data integral to logistical operations governed by computational systems. These are the infrastructural components that generate the possibility of imperial rule for the logistical state. Importantly, the spatial and temporal dimensions described here are not synchronic or spatial equivalents. Time and space is peculiar to each, forming layers or, more likely, a complex undulation of planes that overlap and intersect on some occasions while colliding and disconnecting on others.

The logistical state evolves from what Maurizio Lazzarato identifies in post-war Europe as the social state (*Sozialstaat*), which in turn is a departure from the nation-state: 'The social state is a new kind of state that

has little to do with the nation-state whose loss of autonomy led to its gradual but inevitable disappearance which Schmitt laments' (2015: 52). Lazzarato suggests that the adoption of and identification with the concept of the social state across Europe after World War II 'is symptomatic of a profound change in the nature and exercise of sovereignty'. At the core of this change lies the determinate force of the economy, science and industry, around which the 'political and administrative systems of society' must adapt (Lazzarato, 2015: 52). This reading by Lazzarato of the liberal social state is not to be confused with the social democratic state, a model of governance peculiar to post-war Europe that has become synonymous with the social-welfare state and its crisis following the advent of neoliberalism. For Lazzarato, the social state has already forged a pact with capital.

It should be no surprise that Australia, Canada, New Zealand, the United States, Chile and Japan, following its defeat in the second world war, were leading proponents of the social state. These are countries that historically and to this day have played a role as laboratories in the testing of social and political models designed to extract value from the social relations of production. Technological developments were key to the capacity of colonial empires to appropriate value through processes of capital accumulation. Earlier infrastructural systems on a planetary scale such as electrical telegraphy were notable for their traffic in information related to the pulse of stock markets. The connection of ticker tape to telegraphic signals in 1867 allowed for the continuous registration of fluctuations in market prices (see Standage, 2013: 175). But sovereign states may also refuse to submit to the planetary impulse of technological forms and the external interests – corporate or otherwise – that hitch a ride. States can prohibit the use of infrastructure for the extraction of value if it intervenes, symbolically or otherwise, with its other operations. Again, the Google-China dispute is a case in point, where the PRC exerted the authority to decide that the search engine was violating its Internet censorship laws.

Fusing with finance capital (from rent to tax to speculation, derivatives and other forms of algorithmic trading), the logistical state might also be characterised as a variation of the finance state. However, the intensity of its mode of expropriation suggests that the logistical state is also more than this, which is to say that it is not reducible to financialisation alone. The logistical state, constituted in part by the spatial and temporal properties of infrastructure and their media of operation, is one that extracts new forms of value from populations and dispersing of this value – initially as data and later as financial products and services – through circuits of movement governed by protocols of storage, transmission and processing special to data centres. But importantly, the state does not operate or manage data centres like it previously did in many countries with regard to utilities such as national broadcast media in radio, television and telephony. Instead, the state decides to buy into data centres, including for military purposes.

No doubt there is a danger here of replacing older theories of state formation with a new infrastructuralism. Common to both approaches is an account of the production of subjectivity, either in terms of the constitution of the state-subject (both citizens and non-citizens) or of the logistical agent whose capacity to act is determined by the parametric settings of technical infrastructures of communication and transportation. Within Anglo-American and European traditions of jurisprudence, the territoriality of the state and its declarations of a right to govern is conjoined with the rights of capital to claims over property. Such a pairing has lead to countless instances of dispute and conflict, many of which situate civil society actors as intermediaries in both liberal-democratic and authoritarian states.

Conclusion

In the context of algorithmic capitalism, this article has explored how data infrastructures in the early twenty-first century can be read with regard to their territorial operations. If we take the question of agency as a point of departure to address the peculiarities of our infrastructural present, this does not dispense with the problematic of sovereign power. In our digital present, the infrastructural imperialism of data centres is notably different in terms of a political-technical logic in which the system of nineteenth century colonial mercantilism no longer prevails. This means that infrastructure and territory are not aligned according to the imperatives of empire in which the hegemony of the nation-state and its control of territory was key. Instead, we start to see how a form of infrastructural power predicated on the political economy of data and the territoriality of the logistical state begins to emerge.

While China, Hong Kong, Taiwan and Singapore have been key sites in recent years for the expansion of data centre industries, the conceptual and theoretical work on these installations has not been sensitive to their territorial implications. The territoriality of data is such that in terms of technical operations, labour performance and the materiality of data the locational specificity of 'Asia' is brought into question. Moreover, the capacity of data centres to operate as sovereign entities external to or in conjunction with the state can be understood as a form of infrastructural imperialism.

The extent to which Asia-led globalisation can be thought of as planetary forms of economic and institutional power derived from the hegemony of nation-states and their architectures of alignment such as free trade agreements, special economic zones, public-private partnerships and the like is rendered in material and imaginary ways when considered in terms of logistical practices comprising infrastructural systems, software operations and labour regimes. There is no straightforward architecture of control at work here. Take, for example, my earlier account of BitFury's purpose built data centre in the Republic of Georgia. With its takeover of Hong Kong start-up Allied Control, BitFury subsumed 'Asian' research and development on immersion cooling systems for the mining of Bitcoins. Asian branded knowledge, in effect, is then made operable within the sovereign space of Georgia – a country historically wedged between Soviet, German and Ottoman empires in the early twentieth century.

In focusing on the infrastructural making of space, however, one might begin to ask whether such instances of fairly standard political economy within the commercial sector can also be understood as technological registrations of Asia beyond Asia. If so, then Asia-led globalisation begins to be understood not as a centrifugal force expanding out into the world, but rather as a much more dispersed and uneven manifestation of power generated from technical requirements coinciding within state sanctioned architectures of commercial accommodation. Fibre optic grids of cabling traverse space in patterned ways, duplicating to an extent the imperial cartographies of colonial telegraphic communications infrastructure. But again, such cable infrastructures do not conform to the spatiality of regions or areas as they are typically understood. Similarly, knowledge production and political economy combine on variegated spatial scales, casting assertions of cohesive geopolitical power in highly uncertain ways. It is in these senses that *media determine our situation* (Kittler).

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Notes

This articles draws on and extends material from my book, *Software, Infrastructure, Labor* (2016).

[1] Of course policy making occurs across a range of institutional settings, many of which comprise non-state actors. Importantly, however, the state form has far from vanished or diminished. Rather, it has undergone a period of extended transformation. Later I elaborate one of its various manifestations in terms of the emergent *logistical state*.

[2] It almost goes without saying that in a world of data transactions, culture is largely irrelevant and formats are everything. I leave open the space of qualification, since culture is not entirely irrelevant – there are, for example, strong cultural dimensions that inform engineering practices specific to hardware and software design.

[3] For Saskia Sassen (2013), territoriality is understood as 'the legal construct encasing the sovereign authority of the state over its territory' (21). Importantly, for Sassen, 'territoriality, the legal construct, is not on a one to one with territory – the latter can deborder the legal construct and in this process show us something about the territorial itself' (23).

[4] Radio Astronomy, http://www.radio-astronomy.net/index.htm. See also http://radioqualia.va.com.au/documentation/spacelab/ and http://acoustic.space.re-lab.net/lab/history.html

[5] 'Disposition is the character or propensity of an organization that results from all its activity' (Easterling, 2014: 21).

[6] 'Das Kabel liefert der Welt eine Idee ihrer eigenen Verbundenheit' (Gethmann and Sprenger, 2013: 16).

[7] Thanks to Liam Magee for his input into this passage.

[8] See also the MoneyLab project, an initiative of the Institute of Network Cultures, Amsterdam, http://networkcultures.org/moneylab/

[9] Following a collapse in Bitcoin value over the second half of 2015, there has been a 50 percent surge in

prices. Some observers attribute this recovery to domestic factors in China, including a devaluation of the Renminbi (Yuan) with stresses in Chinese stock markets fuelling a turn to Bitcoin by investors (see Bovairdm, 2016).

[10] See 'Two-Phase Immersion Cooling', 3M, http://www.3m.com/3M/en_US/novec/products/engineered-fluids/immersion-cooling/

[11] And indeed such concepts of the state extend into the 21st century in the work of anarchist critique of bureaucracy and the state by the likes of David Graeber: 'The police truncheon is precisely the point where the state's bureaucratic imperative for imposing simple administrative schema and its monopoly on coercive force come together' (2015: 80).

[12] Or, in a case like Beijing – the political capital of the People's Republic of China – there is an interplay between polis and state that operates in technical, geographic and imaginary ways. This became particularly clear to me during the Beijing Olympics in 2008, when many of the world's global media were gathered to report not only on the sporting event, but also daily social and cultural life in the megacity. Reporters who should have known better would consistently write about the "Great Firewall of China," which periodically blocked social media sites like Facebook and Twitter along with liberal media sites like *The Guardian* and Wikipedia. What these reporters failed to understand was that the Chinese government implemented a digital policy in uneven ways across the territory of the nation-state. In many provinces outside of Beijing, there was no problem to access sites reported as a so-called threat to the authority of Chinese rule. But the government understood very well the metonymic operation between the polis and the nation, which was especially amplified with national and global media events such as the Olympics. The city, in other words, performed the imaginary work of a government in control. It was not necessary to extend control mechanisms beyond the city since most reporters would not venture outside this territorial imaginary.

[13] 'By no means did colonial authorities always have a monopoly over the transfer of information; their adversaries employed similar methods as well as countersystems, from the bush drum to the internet' (Osterhammel, 2015: 425).

[14] On the territorial state, see Branch (2014).

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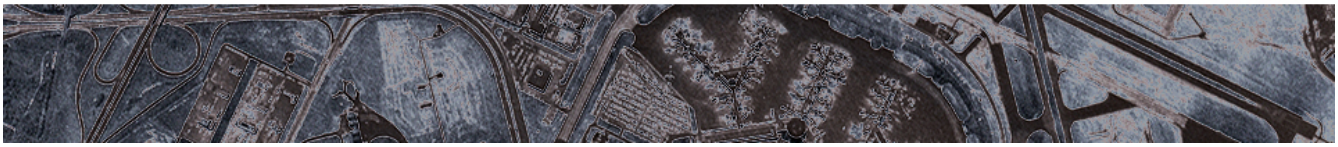

FCJ-221 Collecting Elements of a Minor Future: Commoning in Alphabet City-

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Impressions from an imaginary walk across the streets of Alphabet City, resonant with the architectural echoes of an optimistic modernism, its socio-technological design rooted in a widely shared belief in the governability of urban ecologies.

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Much more than an exercise in urban development, the smart city is the harbinger of a providential processuality, announcing yet another machine age of algorithmic architectures. Marked by the missionary rhetoric and sense of manifest destiny immanent in the infrastructural informatisation of vast cartographies of communication, it is the cloud-based 'city upon a hill' of an imperial imagination, coupling the terraforming of the topographies of life and labor with visions of technological transcendence. In this Alphabet City, there is a multitude of folds to map, but no strategic hill to scale – and only non-places to plant the flags of a new regime. The didactic fictions that organise the semiotics and socialities of 'smart citizenship' are epic in scope, confronting us with the open worlds of a distribution beyond reaggregation. As ambient media changes and challenges what we understand to be the 'environment' of the human, commoning finds itself on the new terrain of a subjective economy, of economies of capture that intervene in processes of collaborative constitution, and of forms of cognition that engender collective commitments to technological solutionisms. As a politics of economic and environmental justice, ambient commoning refers not only to the transformation of our physical environments, but to the ways in which ambient media affects the way we communicate, create knowledge, and engage with others in the pursuit of life and labor.

What follows are impressions from an imaginary walk across the streets of Alphabet City, resonant with the architectural echoes of an optimistic modernism, its socio-technological design rooted in a widely shared belief in the governability of urban ecologies. As we struggle to transform the city into an 'arrival city' (Saunders, 2010) capable of managing multiple migrations, it seems that we no longer share this optimism. Or perhaps it is simply that such imaginary walks exhaust us, our sense of individual and collective agency,

allowing us to embrace both this exhaustion and an entropological sensibility (Stiegler, 2015) more at ease with dissipation than with determination, sharing a sense that distribution is not only a logistical assemblage but our condition. Whichever way we walk, we collect elements of a future fiction to sustain the story of an urban existence not eager to rival the epic narratives of technological empowerment as we, perhaps, simply prefer not to participate, opening ourselves to minor futures that are common rather than exceptional.

Z as in Zorns Lemma

Since there is no linear order in the city of ambient media, we might as well start at the end, the imaginary end of an alphabet, the illusion of a finality. Hollis Frampton's visual essay creates a cartography based on the mise-en-scène of urban typographies (Scheffer et al., 2015a; 2015b). An aesthetic practice revolving around the experimental enmeshments of type and image, typemotion films combine the artistic conviction that film is the aesthetic practice best suited to comprehend the dynamics of the modern metropolis with an awareness of the operative role of writing as a cultural technique: 'So as we follow the movement of type in motion across more than a century of aesthetic experimentation, acts of reading scale our senses to comprehend the topologies across which our contemporary experience unfolds, less in terms of their role in processes of signification than in their role in our logics of existentialization' (Zehle, 2015: 240). And as we walk the streets of the contemporary media city, we cannot but immerse ourselves in its dynamic assemblages.

M as in Ambient Media

Ambient media refers to the 'environmentalisation' of media: from media as (separate) tool to media as environment. The focus on 'ambience' captures the environmental character of media, but also recalls the holistic interest in the ethical implications of ambient media, shared by ambient intelligence pioneers but a minor concern in current ambient intelligence/pervasive computing/ubicomp research. Technologically, this shift is driven by a series of overlapping ICT developments, including the availability of real-time networking infrastructures and the deployment of sensor networks especially in urban contexts. In terms of interface design, the disappearance of media into our environments is a consequence of the shift from command line/graphic user interfaces toward natural user interfaces (gesture/touch, speech, eye/motion tracking). Economically, this shift is supported by new economies of capture and commodification aiming to integrate the data (exhaust) we generate into new value chains, including (in the US) the 'Big Five' (Amazon/Apple/Facebook/Google/Microsoft), a GE-led 'Industrial Internet' coalition (including AT&T, IBM, Cisco, and Intel) inspired by the analytics of infrastructure automation, and a corporate 'sharing' economy designed to operate below current regulatory thresholds of economic and environmental justice (Sterling, 2014 & Scholz, 2014). Politically, this shift has been supported by enthusiasm for big data and internet-of-everything policies and strategies as well as the prioritisation of technological over cultural, economic or social innovation. Raising hopes for the democratisation of processes of governance, the arrival of ambient media continues to meet with growing resistance to private (commercial/corporate) and public (intelligence/security) surveillance (Schneier, 2015).

D as in Distribution

We lead lives ruled by distribution – as a logic, as a layer of technological systems design, as a logistical assemblage. Facilitated by new approaches to infrastructure studies, analyses of ambient media have drawn attention to the scope and structure of logistical systems. Comprehending the infrastructural socialities of a new era of surveillance-based services in logistical terms, they remind us of the primacy of distribution – of labor, of political sovereignty, of the technical object – in the design of supply chains, of forms of governance, of objects. The reaggregation of agency and accountability distributed across 'post-political' infrastructures (Wark, 2014) to reach the critical mass and thresholds of visibility required by a politics of representation is a struggle, if not considered an already lost battle. The fiction of real-time governance is an epic story with unknown beginnings, the endless series of an authoritarian machinism whose opening season we have always already missed. There will be no zero-latency democratic decision-making. Somewhat surprisingly, distribution confronts us with the limits of democracy, not only as the transcendental dilemma of distributive justice (Hardt and Negri, 2010) but of the sovereign logic of technological distribution. Less surprisingly, the despair is graspable across the digital society: What used to be the public sphere of agonistic encounters is now an empty parking lot next to a data center, a strip mall abandoned by ecommerce enthusiasts leaving room for little more than a mock trial of search algorithms. Of course, the nostalgia for agonistic encounters is rooted in a romance with the political. But it is an agon based on our comprehension of politics as aesthetic practice, perhaps in the form of a populist drama staged to put the sublime objects of a sensuous sociality into circulation (on Podemos, see Mouffe and Errejón, 2015), perhaps as situationist game of war striving to master lines of communication (on the Panama Papers, see Harding, 2016). We have no choice, it seems, but to accept the determination of sovereignty by distribution.

A as in Algorithmic Accountability

Accountability is not a model of politics; it is, above all, a principle of design. So before we resign ourselves to popular fatalisms (we love the apocalypse and its decisionist designs of the political), we can and should subject the parameters and protocols of assessment and automation to public scrutiny (Pasquale, 2015) – if only to better comprehend the role of the semiotics of software in new regimes of governance (CFTC, 2016). Not, however, to simply rekindle the hopes of a new era of openness and transparency, where data is folded back into existing mechanisms of a politics of representation – access alone cannot change the fictions that organise the semiotics and socialities of algorithmicised agency. But even the modest approaches of algorithmic audits can already help us assess whether and which existing mechanisms established to guarantee information freedoms remain useful in strategies of ambient commoning; the same holds for the blockchainisation of such strategies (O'Dwyer, 2015). And of course we can take algorithms to court; we have taken animals to court (Fischer, 2005; Humphrey, 2002), and there might be a model there – not of getting algorithms to accept their guilt, but to elaborate the standards of human sociality in ways that facilitate our comprehension of the dispositions of machinic systems (Easterling, 2014).

E as in Experience Engineering

To understand ambient media, we let go of the concept of agency as a capacity that is always already given and instead attend to the dynamics of subjective constitution – to the ways in which (ambient) media affect

our capacity for cognition and relation. As a condition and consequence of the individualisation and personalisation of digital goods and services, experience itself has become a key terrain of economic valorisation. The concept of a 'subjective economy' shifts attention from goods and services to the implications of these developments for individual personhood and the ways in which they constitute and constrain the agency of individual and collective subjects (Lazzarato, 2014). Because the subjective economy of ambient media operates on the commons of our affective and cognitive capacities for communication, commoning engages the question of access to the conditions of subjectivity. As the individual subject becomes the focus of new growth paradigms, the question of agency – its constitution, scope, and forms of articulation – acquires a new relevance as the subjective economy exhausts, exploits, and empowers us at the same time. The ambient commons is not only about standards or technologies open to multiple forms of reappropriation, but about who we become when we communicate.

C as in Ambient Commoning

The idea of an ambient commons takes its point of departure our position in the subjective economy, combining attention to the transformation of experience with analyses of the infrastructural changes that make this transformation possible. An increase in individual freedom (especially if pursued by following the model of consumer choice) is not necessarily accompanied by an increase in social freedom: the freedom to have a say regarding the nature and number of choices available, the freedom to be involved in processes of collaborative creation. A commons is a general term for shared resources in which each user has an equal interest. Relations among users are based on collective governance frameworks of interdependence, cooperation and shared use rather than exclusive property rights. In the analysis of sustainability, the commons has been one of the most significant concepts, increasingly applied to computational environments. Long dominated by ahistorical accounts of the so-called 'tragedy of the commons' (overuse as a consequence of the absence of regulation, an 'absence' that effectively ignored the rich tradition of governance systems based on neither state nor market), contemporary analyses have emphasised commoning as a form of collective self-determination aimed at maintaining and reproducing commons for present and future use. Because its cultural, economic and political conditions of possibility are distributed and regulated across multiple layers of governance, a commons is always both local and translocal. A focus on the enclosure of the ambient commons broadens the horizon of analysis beyond the digital society and the short history of ambient media, linking contemporary practices of commoning to the archive of historical practices of self-determination and collective governance (De Angelis and Harvie, 2014).

T as in Cultural Technique

Since ambient media confronts us with a new set of environmental concerns, we need to comprehend media both as a set of discrete technologies (subject to co-design, reappropriation, and collective governance) and a condition, changes in which call for a more comprehensive politics of sustainability. As core dynamic of such a politics, ambient commoning can be understood as a cultural technique. Rather than struggling against the hegemony of technological innovation, we should politicise its optimistic faith in technological solutions, if only to concretely engage with the limitations of a technological solutionism. Or to conclude that we need even more technological innovation – but not on the level of objects, rather on the level of the cultural techniques that organise their constitution and couple them with others actors in chains of operation. The concept of cultural technique has been adapted from the domain of agricultural

engineering to address processes of cultural constitution and counter the analytical tendency to explore the symbolic rather than the material (ontological) dimensions of culture (Siegert, 2015). As such, cultural technique offers a way to acknowledge the cultural, economic and social registers of commoning and comprehend multiple articulations of resistance and resource governance. Such a cultural technique is both hybrid in its adaptation of existing practices and perspectives, and distributed across different political forms and practices. The concept of cultural technique resonates with philosophical accounts of the co-evolution (or co-originarity) of technology and the human, a point of departure for analyses of the physiological and psychological implications of the environmentalisation of media. In cities like Bologna (Foster and Iaione, 2016) or Barcelona (Utratel, 2016), a new generation of urban policymakers is already engaging these dynamics through commons-based techniques of urban governance.

U as in Complete Users

Above and beyond the nostalgia of craft and custom manufacture (and the unexpected return of undead creative industries frameworks), one of the effects of new maker movements has been to expand the horizon of digital literacies – acknowledging the need to shift from the 'critical use' of existing infrastructures to their co-design, and perhaps even more importantly, encouraging us to hold on to the figure of the 'complete user' envisioned in the comprehension of computation as a general purpose technology (Lialina, 2012). If the tentative tale of a common city is to have any chance of countering the massively-multichannel fictions of the city of capture, we will need concepts of comprehensive agency at the core of our storytelling. The figure of the Anthropocene has been suggested to help imagine the fullest-possible scope of human agency across spatial and temporal scales; maybe the complete user is simply another figure for the human living under the condition of distribution. And if a polyamourous operating system can embark on a quest for self-knowledge and the zen of technology (Jonze, 2014), why shouldn't we, aided by xenofeminist enthusiasm regarding the reconfigurability of the human machine?

I as in Seamful Interfaces

If we begin to comprehend a medium at the time of its disappearance (the instant institutionalisation of digital humanities notwithstanding, media theory is always limited by its own epistemic latencies), it seems that given the healthy state of interface theory, interfaces are about to disappear. It so happens, however, that the current state of interface design is less interested in complete users than one would expect, given the endless string of empowerment commercials that accompany product releases. The environmentalisation of media has been driven by a focus on experiences that prioritises seamlessness to the extent that both the 'inter' and the 'action' parts of interaction are about to disappear from view. Embraced by pioneers of ubiquitous computing who already anticipated the becoming-invisible of computational technologies (Weiser, 1991), the idea of seamlessness stresses the intuitive interaction with computational systems. Moving toward natural user interfaces (touch, speech, eye-tracking), designers have successfully expanded the range of users by lowering the thresholds for interaction. At the same time, new thresholds have been created through closed hard- and software systems offering use based on a take-it-or-leave-it model. The disappearance of seams is, then, perhaps more usefully understood in the crude terms of political economy rather than the flashy idioms of UX design. Instead of imagining ambient media as a seamless space of frictionless communication, imagine it as a bordered space of conflict and recall that what is cast as friction in visions of 'frictionless capitalism' (Gates, 1996) or 'frictionless experience' (Zuckerberg, in Eldon, 2011) is the conflictual dynamic to be engaged by commoning strategies.

Because interfaces are experience architectures, the valorisation of 'invisible interfaces', a major element in the environmentalisation of media and an influential aesthetic principle, has far-reaching normative implications. Seamless rather than 'seamful' design approaches focus on constraining (in the name of efficiency, freedom, and simplicity rather than control) the powers and potentialities of the 'complete user' implied in the comprehension of computing as a general purpose technology. 'Seamful' design strategies are to 'invisible design' what experimental film is to continuity editing, that is, a form of aesthetic resistance to the disappearance of the work and workings of montage. Whereas seamless invisible design makes work (and with it alternative forms of agency and expression) disappear, the seam is the potential site of a politics. The distribution of power lines and the location of power plants have already been focal points of political contestation, suggesting that whenever infrastructures become visible, they also become graspable as potential objects of a politics. Such terrains of common experience are a reminder of the direct link between shared use and infrastructural design. Hiding the materiality of technical systems not only limits our capacity to use them in creative ways. It also regulates access to the very means involved in our individual and collective self-constitution.

E as in Common Ecologies

While ambient media is a rather recent development, we are already aware of its ecological and social costs: natural resource exhaustion, increasing energy use, rebound effects of mass consumption that outpace any efficiency gains, new waste streams, occupational health and safety concerns across supply chains and workplaces, and the need for sustainable design – all of which have been the focus of electronics activism (Good Electronics Network). Commoning cuts across and couples ecologies, not least because in our experience they already flow together. Rights to informational self-determination and rights to non-toxic technologies, for example, are not exercised in different worlds. Their separation is not a given but an effect of governance by different epistemological and political regimes – concern over climate change notwithstanding, we continue to analyse and govern 'the economy' and 'the environment' by separate institutions. The existence of the common is not the result of a choice, to embrace and enact different theories of property, for example. The commonality of ecological effects is an irreducibly collective experience; we cannot but share this space of continuity. And the deterritorialising discharge from electricity generation and electronics production, for instance, not only cuts across the geographies of sovereignty – toxic dusts, flows, and seepages also remind us of the leakiness of our conceptual containers. We do not have to create the common, it already exists as material actuality.

P as in Parametric Politics

In the sense of commoning as a cultural technique that links actors and objects in new chains of operation, to engage in remaking this world of ambient media is to envision a redesign of its operational infrastructures. A comprehensive imagination of urban infrastructures as dynamic system brings into view the protocols and parameters that define these operations. This can mean building on maker and design thinking approaches as well as embodied cognition research for hands-on methods to imagine and co-design new interfaces that can operate as sites of commoning and commons-based production, but also the codes of new currencies aiming to reorganise the distribution of wealth (Terranova, 2014) in the common city. And because attention to the transformation of agency necessarily includes the transformation of labor, a parametric politics must address both economic and environmental justice. The separation of the politics of labor and those of the environment, one of the consequences of our collective

insistence on culture-nature distinctions, does not make sense in the context of ambient commoning.

To focus on walking is to evoke figures such as the flâneur or the Lettrist dérive, surrounding our strolls across the sentient semiospheres of the 'smart city' with an appropriate atmosphere of nostalgia but also return to walking as a practice of self-distribution. Such walks are, necessarily, a hybrid experience, as we cease to pit analog and digital spaces against each other since we no longer expect dichotomous discretisations to secure realms of experience. The 'we' that emerges is, perhaps, the accidental we of collectivities encountered in the course of roaming the streets of our cities, perhaps also the we of early dystopian accounts of total transparency that expand our sense of contemporaneity beyond current articulations of computationality (Zamyatin, 1924). The subject of these experiences is not simply an I, and its horizon much wider than that organised by a 'quantified self' engaged in economies of optimisation. We need the space of a we, whatever the we, to create conceptual constellations that can facilitate our exploration of the enmeshment of our expression with the a-signifying semiotics of machinic communication. From the becoming-mobile of our gaze, explored in the serial photography of Charles Malville that accompanied the Haussmanisation of Paris, the street photography pioneered by Eugene Atget, or the modernist mise-en-scène of urban experience in the city symphonies of Calvalcanti, Strand and Sheeler, or Vertov to our current engagement with the 'nonconscious cognition' (Hayles, 2014) of the machinic systems sustaining the sentient city of infrastructural informatisation: to walk the streets is to encounter Alphabet City on the ground level, as an aleatory alphabet that announces the possibility of a shared story even without a full sense of its plots and protagonists, of its storytelling architecture.

The 'epic struggle' (Sterling, 2014) for the future of environmental media also calls for stories that comprehend the 'total configurations' (Rams, 1976) that cut across processes of technical and subjective constitution, stories that reimagine design on the level of institutions. We are in the process of creating of tools to facilitate such storytelling – infrastructure studies train our analytical gaze to follow the constitution of technical objects across vast supply and value chains, software studies and analyses of the subjective economy teach us how to comprehend the mixed semiotics of semi-autonomous systems, the vision of an 'extrastatecraft' (Easterling, 2014) reminds us that we cannot simply map the dynamics of collective self-determination onto the matrices of state, market, and civil society, the geologisms of the Anthropocene encourage us to reflect on the reach of human agency beyond 'smart citizenship'. At the same time, there is no need to rival the epic scope so characteristic of the empowerment narratives that have accompanied the environmentalisation of media. We already know there is no outside: all consequences of our actions remain in the same space of shared experience. In this context, the role of the figure of the ambient commons is not only to suggest new cartographies of this shared space. It challenges the spatial imagination of our sense of the political. And as we live in this space, scaling our senses above and beyond the horizon of micropolitical solutionisms, there is no need to subsume such sensing to a new master narrative, as even minor fictions can be turned into a series of minor futures.

Biographical Note

Drawing on perspectives from comparative literature, philosophy, and translation, Zehle’s research interests include the role played by media architectures in framing our communicative modes of relation. Lecturer in Media Theory at the Academy of Fine Arts Saar, he also co-initiated and currently works as managing director of the academy’s xm:lab - Experimental Media Lab.

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