Environment and Planning D: Society and Space 2014, volume 32, pages 869 – 885

doi:10.1068/d13041p

Michel Foucault and the smart city: power dynamics inherent in contemporary governing through code

Francisco Klauser
Institut de Geógraphie, Université de Neuchâtel, Espace Louis Agassiz, Neuchâtel 2000, Switzerland; e-mail: francisco.klauser@unine.ch

Till Paasche
Soran University, Soran City, Kurdistan, Iraq; e-mail: till.paasche@soran.edu.iq

Ola Söderström
Institut de Geógraphie, Université de Neuchâtel, Espace Louis Agassiz, Neuchâtel 2000, Switzerland; e-mail: ola.soderstrom@unine.ch
Received 6 June 2013; in revised form 9 March 2014; published online 12 August 2014

Abstract. Drawing upon Michel Foucault's approach to power and governmentality, this paper explores the internal logics and dynamics of software-mediated techniques used to regulate and manage urban systems. Our key questions are as follows: what power and regulatory dynamics do contemporary smart-city initiatives imply? And how do smart information technologies intervene in the governing of everyday life? Building on the Foucauldian distinction between apparatuses of discipline and apparatuses of security, the paper approaches these questions on three broad levels, namely: how contemporary 'governing through code' relates to its referent object (referentiality axis), to normalisation (normativity axis), and to space (spatiality axis). Empirically, the paper investigates two high-profile pilot projects in Switzerland in the field of smart electricity management, aimed at (1) the assessment of customer needs and behaviours with regard to novel smart metering solutions (iSMART), and (2) the elaboration of novel IT solutions in the field of smart electricity grids for optimised load management (Flexlast).

Keywords: smart city, governmentality, power, smart meters, smart grid, security, Michel Foucault, surveillance

Introduction

Recent urban policy debates have been heavily influenced by discourses reiterating the promises associated with 'smart' information technologies (ITs) in terms of optimising the management-at-a-distance of urban infrastructures. In Switzerland, as elsewhere, numerous IT-based smart initiatives are being set in motion, relating to a wide range of services and systems, from electricity grids to public transport and traffic management. One of the many terms used for towns and cities embarking upon such initiatives and developments is 'smart cities'.

Although there is today no consensus regarding how exactly to define the IT-mediated 'smartness' of urban infrastructures (Giffinger et al, 2007, page 10; Hollands, 2008), or which projects, practices, and technologies to subsume under the umbrella term 'smart cities', it is possible to identify at least three interrelated centres of gravity around which most approaches navigate. This outline takes into account only those literatures that understand smart cities as instrumented—ie, computerised—urban systems [for a wider overview of alternative smart-city approaches, stressing creativity, innovation, and entrepreneurship, see Kitchin (2013)].

Firstly, discourses on smart cities emphasise the novel possibilities of generating, gathering, and processing data which arise from the digitisation of urban systems in the present-day world. Secondly, smart-city developments are presented as the result of novel possibilities to interconnect and to fuse various types and sources of data relating to various

aspects of everyday life. Thirdly, the smartness of cities is frequently set in relation to data analytics, thus approached as the correlative of the increasingly automated management of urban systems. The key point here is software, understood as predefined lines of code that process and analyse data with a view to generating automatic responses (Kitchin and Dodge, 2011; Thrift and French, 2002).

In sum, smart cities are presented as the object of a wide range of technologically mediated practices of management at a distance, based on orchestrated assemblages of computerised systems that act as conduits for multiple crosscutting forms of data collection, transfer, and analysis. At their core, efforts towards smart cities thus imply a world of optimised ordering and regulation that relies fundamentally on the coding of social life into software (Haggerty and Ericson, 2000; Lyon, 2007). In other words, smart cities subsume a heterogeneous range of techniques and efforts aimed at governing through code.

Of course, techniques and efforts towards the increased IT mediation of urban systems are neither new nor unique to smart cities. What is interesting is that in smart-city developments a wide variety of techniques and efforts join in a holistic approach (Klauser, 2013). Thus the projects and efforts surrounding smart cities cover many phenomena and services, on differing spatial scales, from 'augmented' buildings to city administration, mobility, and energy management.

There are also different readings of smart cities in terms of normative stance and assumed benefits. Discourses on smart cities by technology companies and policy makers often contain a marked reference to visions of technology-induced progress, related to societal, economic, and environmental issues. Such promises have inspired many studies focusing on and indeed promoting the IT-enhanced management of urban systems, aimed, for example, at improved efficiency and reduced pollutant emissions (Bakıcı et al, 2012; Fischedick and Lechtenböhmer, 2012; Streitz, 2011).

However, some recent academic work has started to question the assumption that smart information technologies simply pave the way for a "prosperous and sustainable future" (IBM, 2010, no page number). For example, Hollands (2008) emphasises the urban marketing rationales underpinning contemporary smart-city talk, while Bell (2012) focuses on smart-city discourses as a typical expression of the wider contemporary trend of engineerist approaches to urban governance. More recent contributions by Townsend (2013) and Greenfield (2013) further pursue and deepen these critical analyses from a historical and discourse-analytical viewpoint.

Furthermore, albeit not necessarily framed around the notion of smart cities, a rapidly developing literature has in recent years explored and problematised the surveillance potential and power issues implied by the increased digitisation and informatisation of urban systems and services (Bunnell, 2004; Eger, 2003; Galloway, 2004; Komninos, 2002). This emerging cross-disciplinary field has highlighted the social and personal consequences of the increased possibilities of knowing, tracking, data mining, and profiling everyday life. It has also generated a more detailed understanding of the functioning of smart information technologies, the interests they serve, and the wider societal effects they produce (Amoore, 2009; Cost Action IS0807, 2008; Franko Aas et al, 2008; Jones, 2001; Langheinrich, 2009; Lyon, 2003).

Power dynamics in smart electricity management

The present paper is part of a series of three cowritten papers that study and conceptualise the making, functioning, and implications of smart cities from several theoretical and thematic perspectives. The three papers aim to explore (1) the discursive construction of contemporary smart-city initiatives and policies (Söderström et al, 2014), (2) the power struggles and coalitions of expertise and authority across different geographical sites in the making and subsequent exemplification of the 'smart city' as a novel urban policy model, and (3)—in

the case of the present paper—the logics and regulatory dynamics inherent in novel smart-city projects. These investigations result from a two-year research project focused on smart technology applications in the fields of traffic and electricity management.

This third paper contributes to contemporary smart-city debates in a very specific conceptual and empirical way. Building on Michel Foucault's approach to power and governmentality, and drawing upon empirical insight provided by case studies of two projects (iSMART and Flexlast) relating to smart electricity management in Switzerland, the paper explores the internal logics and dynamics of software-mediated techniques of regulation and management at a distance of urban systems. Our key questions are as follows: what power and regulatory dynamics do contemporary smart-city developments imply? And how do smart information technologies intervene in the governing of everyday life? Deploying in particular Foucault's concept of 'security' as an analytical heuristic, the paper approaches these questions on three broad levels; namely, how contemporary governing through code relates to its referent object (referentiality axis), to normalisation (normativity axis), and to space (spatiality axis).

Empirical approach

The two projects that will be explored empirically in what follows deserve some initial explanation before we move on to outline in more detail the conceptual approach pursued in the paper. The iSMART project constitutes a flagship project for Switzerland. It is devoted not only to the development of novel answers to the technical and organisational issues surrounding the introduction of smart electricity meters, but also to the study of customer behaviours and needs associated with the meters (BKW, 2009, page 33). As part of the project, 300 households in Ittigen—a municipality of 11 000 inhabitants, near the city of Bern—were equipped with smart meters and a mobile device (an IP phone with integrated multimedia services). This enables BKW, the electricity provider in the canton of Bern, to study the participants' uses, perceptions, and experiences of this new way of monitoring and managing electricity consumption. Since 2012, two additional projects have been incorporated into iSMART: PowerVISU (aimed at the visualisation and management at a distance of domestic photovoltaic installations) and FLEX (allowing domestic hot water tanks to be controlled and heated automatically by software, depending on fluctuations in both people's electricity needs and the availability of electricity).

The Flexlast case study offers an additional level of technological complexity to this discussion. Flexlast uses three refrigerated warehouses owned by the retailer Migros for the storage of thermal energy, which act as a buffer to help balance fluctuations in the availability of renewable energy on the grid. The key challenge of the project is to calculate and model the exact buffer potential of the warehouses at a given time, depending on anticipated storage volume and logistic activity. The energy in the warehouses can be activated as needed, for better supply and demand matching on the grid. Thus, Flexlast constitutes one of the most ambitious pilots in Switzerland in the field of smart electricity grids (Bundesamt für Energie, 2012; IBM, 2012).

Both iSMART and Flexlast are supported and shaped by IBM and BKW, together with other partners. In the case of Flexlast, the Swiss Federal Office of Energy provides the project funding. Our analysis of the two projects draws upon the extensive study of official documents and reports relating to the two projects, combined with twenty-two semistructured, qualitative interviews conducted in 2012–13 with the partners involved.

Governing through code seen through the lens of Foucauldian 'security'

There are three main reasons that we draw on Foucault's approach to power and governmentality in our study of the regulatory dynamics inherent in iSMART and Flexlast. The first reason is one of perspective. Foucault reiterates again and again that power,

conceived as a capacity to "structure the possible field of action of others" (1982, page 790), must be approached through the study of its mediating techniques and discursive regimes, rather than as the property of specific actors. Thus he shifts the focus of analysis from the subject or outcome of power to the technically mediated process of power "put into action" (page 788). Regarding the context of contemporary "techno-politics" (Mitchell, 2002), this naturally directs our attention to the means and logics through which techniques of governing through code organise and manage everyday life. This is exactly what we want to explore in this paper.

The second reason for our insistence on Foucault relates to his wider ambition to develop a conceptual framework for the study of differing apparatuses of power (governmentalities), understood as historically situated ensembles of techniques for organising and regulating the objects and resources of governing (Foucault, 2008, page 186). This ambition distinguishes Foucault's work from other theoretical approaches to power and control, offered by authors such as Deleuze (1992), Baudrillard (1994), and Bogard (1996). Furthermore, in differentiating, for example, between juridico-legal, pastoral, disciplinary, and security types of power, Foucault (2007a) offers a metalevel of analysis that moves beyond a mere description of the specific techniques and discursive regimes through which power acts, to focus instead on the crosscutting rationalities that characterise differing modes of power anchored in specific milieux and historical contexts. Consequently, Foucault's governmentality framework implies a move from the particular to the general, and from the descriptive to the analytical, that goes beyond the reach of other relational and mediation-centred approaches, such as actor-network theory (Latour, 2005). This strongly adds to Foucault's appeal for our purposes.

The third reason that we find Foucault of particular relevance for the present paper is his conceptualisation of (the apparatus of) 'security' as opposed to (the apparatus of) 'discipline'. More specifically, this paper starts from the assumption that in Foucault's security we find a conceptual tool that allows the emphasis and exploration of the intrinsic flexibility of contemporary governing through code, in its relation to reality, normalisation, and space (Klauser, 2013; Klauser and Albrechtslund, forthcoming).

This thesis neither implies that contemporary governing through code entails a strictly homogeneous range of techniques in terms of their regulatory logics, nor suggests that these techniques should be regarded exclusively as the expression and correlative of Foucauldian security. Rather, our key argument is that Foucault's conceptualisation of security offers a powerful analytical heuristic through which to explore some (but not all) of the power dynamics inherent in contemporary governing through code.

The paper also lays stress on a range of principles and issues characterising current smart-city developments that Foucault neither explored nor foresaw, but which develop his conceptual and historical framework in very interesting ways. In this sense, our analysis contributes not only to the operationalisation but also to the extension of Foucault's approach to governmentality and power, from a viewpoint centred on the problematics of contemporary governing through code.

In many ways, this discussion connects with and reacts to those literatures which have in recent years criticised Foucault's work on the panopticon (and thus on disciplinary power) for missing the inherent flexibility and fluidity of contemporary forms and formats of control. Often, such claims have been inspired by Deleuze's (1992) propositions on the concept of the 'control society' (see also Boyne, 2000; Hardt and Negri, 2000; Lianos, 2003; Murakami Wood, 2010). What is often ignored in such discussions is that Foucault's own work—most notably his lecture courses given in the late 1970s at the Collège de France (2007a; 2008)—offers a hugely inspiring contribution on this very issue, centred on the concept of security. We feel that this contribution has not yet been fully appreciated by scholars working on

contemporary techno-mediated forms and formats of control and regulation—neither in geography (Hannah, 1997; Huxley, 2008; Kitchin and Dodge, 2011), nor in surveillance studies (Gandy, 1993; Murakami Wood, 2010; Norris and Armstrong, 1999)—and that it still awaits a solid, empirically grounded operationalisation from a micro perspective. In order to contribute to this task, we first need to operationalise Foucault's concept of security as opposed to discipline, by showing how and on what levels the two can be distinguished.

Security versus discipline

In developing a conceptual framework for the study of differing, historically situated apparatuses of power, Foucault attributes disciplinary power to the 18th-century context of European modernity, whilst he sees security as the logic of power that characterises contemporary Western liberalism from the middle of the 18th century (2007a, pages 6, 48, 96). Importantly, however, Foucault stresses that his typology of differing "arts of governing" (2007a, page 92) distinguishes between internally heterogeneous "forms of coherence" (2008, page 42) rather than between clearly distinct edifices of internal homogeneity. In other words, different types of governmentality differ in gradual rather than in fundamental terms. Their predominant "rationalities" (ways of knowing a phenomenon) and "technologies" (ways of acting on it), as Miller and Rose (2008, page 15) put it, vary in overall focus and emphasis rather than in nature.

What matters most for our purposes here is to show how and on what levels Foucault approaches the distinctions and variations between discipline and security. We discuss three levels of distinction below, focusing on how Foucault opposes the two apparatuses with regard to (1) the governed reality or referent object of governing (referentiality axis), (2) normalisation (normativity axis), and (3) space (spatiality axis). This tripartite structure does not provide a definitive or comprehensive guide for organising Foucault's wide-ranging power investigations, but merely offers one possible organising framework, which we hope will prove a useful heuristic in the analysis of iSMART and Flexlast that follows.

Referentiality

The first broad level of analysis on which Foucault distinguishes security from discipline concerns how power in the two apparatuses relates to its referent object (referentiality axis). The main questions are as follows: how is the governed reality approached and conceived? How does power relate to the uncertain, which is inherent in the governing of multiplicities?

Whilst Foucault insists that both discipline and security are concerned with governing reality as a multiplicity of activities, objects, people, etc, he argues that they do so from differing perspectives and according to differing a priori principles. Discipline, on the one hand, designates a specific way of managing multiplicities through techniques of individualisation (2007a, page 12). Thus disciplinary normalisation consists in breaking down a given multiplicity (of people, behaviours, etc) into specific components, as both the locus and referent object of power put into action (2007a, pages 56–57).

Security, in contrast, works on the relationship between components of a given reality, instead of focusing on the singularised entities separately (Foucault, 2007a, page 47). Reality is approached as a relationally composed whole whose components are deciphered in their intertwined articulation, with a view to their coordinated normalisation. What matters is the optimised adjustment of the assembled components of reality depending on and in relation to each other.

Whilst discipline is essentially centripetal in function and telos—ie, singularising, concentrating, and enclosing—security is centrifugal, constantly expanding and aiming to decipher and interlink ever more extensively and intensively approached components of reality. Thus discipline and security imply not only two fundamentally opposed ways of conceiving and analysing different components of reality and relationships between them,

but also two fundamentally opposed a priori principles. Discipline starts from an external, preestablished normative model, whilst security proceeds from the internal, decoded 'normalities' of reality, with a view to optimising their interplay (Foucault, 2007a, page 63). In sum, the relationship of discipline to reality is singularising, essentialist, and, in its derivation from a pregiven normative model, absolute. Security, in contrast, adopts a perspective on reality that is pluralising, relational, and relativist (in its derivation from the study of the internal, interdependent normalities of a given reality).

Normativity

The second level of analysis relates to the question of how power in the apparatuses of discipline and security relates to normalisation (normativity axis). The normativity axis implies a focus not only on the aims of governing, but also on the logics and conception of normalisation itself. How do discipline and security conceive of the norm, and of the normal? What does this mean for normalisation?

As mentioned previously, discipline starts from a predefined optimal model that is applied rigidly to the entities individualised for normalisation. The apparatus of security, in contrast, lets things happen within the limits of the acceptable, whilst also regulating and monitoring them with a view to the optimisation of reality in its intertwined components. There are three main consequences of this basic stance: firstly, it follows that security does not postulate a perfect and final reality to be achieved, but a constant process of optimisation derived from and taking place within a given reality, whose aims and conditions are constantly readapted and redefined, depending not only on the ever-changing parameters of reality itself, but also on the shifting context and conditions of regulation (for example, cost calculations, public opinion, and availability of novel control techniques). Thus normalisation in the apparatus of security is inherently processual in its aims and basic conditions.

Secondly, the normative logic of Foucauldian security is fundamentally flexible in its management of reality. The limit of the acceptable is not merely conditioned by a rigid binary opposition between the permitted and the prohibited, but calculated from and adapted to the differential normalities that characterise the governed reality. The question at stake is how to know, regulate, and act upon this reality within a "multivalent and transformable framework" (Foucault, 2007a, page 20).

Thirdly, if normalisation in the apparatus of security starts from the decoding of reality in its interacting components, this also means that these components are not valued as either good or bad in themselves, but taken to be necessary, natural (in the broad sense) processes that are granted freedom to evolve according to their internal logics and dynamics, within the acceptable limits of the system (Foucault, 2007a, page 45). For Foucault, security implies a certain level of freedom—broadly conceived as the "possibility of movement" (2007a, pages 48–49)—as its basic condition (2007a, page 49). Put differently, for Foucault, security designates the regulatory regime inherent in the (liberalist) art of government that aims at the management of freedom, on the basis of the organisation, fixation, and control of those conditions within which freedom is made possible (2008, pages 63–64). The important point arising here relates to the contextual logic of normalisation in the apparatus of security. Through techniques of control, calculation, incitation, etc, security aims at the establishment of those conditions and limitations within which the components of reality are to be optimised in their entanglements and aligned internal logics. Thus, on the contextual level, security also relies on prohibitive, coercive—in sum, disciplinary—techniques of power.

Spatiality

Foucault also distinguishes between discipline and security "by considering the different ways in which they deal with and plan spatial distributions" (2007a, page 56). This geographical side of Foucault has sparked a number of debates over the years, resulting in a sort of

"geo-governmentality school", as Elden and Crampton put it (2007, page 6; see also Crampton and Elden, 2006; Dillon, 2007; Elden, 2001; Huxley, 2008; Philo, 1992). The third broad level of analysis retained here thus relates to the problem of space (spatiality axis). What forms of spatial organisation do discipline and security produce, and, in turn, how does spatial organisation mediate the exercise of power in the two models?

The disciplinary problem of space, for Foucault, is one of enclosure, fixity, and internal structuring, following the need to spatially organise and subdivide artificial multiplicities into singularised entities (2007a, page 17). In *Discipline and Punish* (1977) Foucault explores this spatial rationality with particular reference to the figure of the panopticon as a paradigmatic spatial model of disciplinary power in action (Hannah, 1997).

The spatial logic of security, in contrast, is one not of fixed structuring and enclosure but of managing multiplicities as a whole, in their openness and fluidity. "Spaces of security" (Foucault, 2007a, page 11) respond to the need to regulate, optimise, and manage circulations "in the very broad sense of movement, exchange, and contact, as form of dispersion, and also as form of distribution" (2007a, page 64). The aforementioned conception of freedom as the "possibility of movement" (2007a, pages 48–49) thus also has a spatial meaning.

If discipline and security differ in their spatial problematics and functioning—fixity and enclosure versus circulation and openness—they also contrast in their respective conceptions of spatial organisation, with regard to its mediated and mediating relationship with power (Klauser, 2013). In disciplinary governing, on the one hand, spatial organisation is conceived as something that must be constructed anew, starting from a pregiven raw material. The aim is to arrive at a point of perfection at which spatial organisation fully responds to, and in turn enforces, a pregiven optimal model (Foucault, 2007a, page 19). Again, the figure of the panopticon—in its ideal-typical architectural form aimed at normalisation through spatial organisation—offers a powerful example of this.

Security, on the other hand, approaches spatial organisation as something that relies on and derives from the inherent multidimensionality and 'distributedness' of space, to use Nigel Thrift's expression (2006, page 140). Here, space is not conceived as a pre-given raw material to be constructed anew, but as a complex 'composite', made of interlocking, overlapping, and distributed (ie, not necessarily colocated) dimensions, which are deciphered and optimised in their interrelations. This demonstrates, on the level of spatiality, the aforementioned centrifugal reflex of security to approach the entangled components of reality ever more extensively and intensively, with a view to their combined governing.

Governing through code in its relation to reality

Having outlined the Foucauldian distinction between security and discipline, we now start our analysis of the power dynamics implied by contemporary smart-city initiatives. Our first level of analysis focuses on how the techniques of governing through code inherent to iSMART and Flexlast relate to the managed reality itself (referentiality axis).

Governing through interrelation

> "BKW backs the use of renewables, based on efficient technology solutions. … Given the volatility of the renewable energy supply chain, a growing need is to be expected for smart load management solutions that allow for the alignment of energy consumption and provision. Typically, a situation of strong winds and low energy demands results in a system imbalance, which is exactly when we would need to switch on further appliances" (BKW corporate developer 1[(1)]).

[(1)] All quotations taken from the interviews relating to iSMART and Flexlast have been translated from German by the authors.

This quote, taken from one of our interviews conducted with BKW, reveals the main purpose of iSMART and Flexlast: both projects aim to align the availability of electricity with its consumption, with a view to maintaining the stability of the grid in a context of increased use of renewable energy. In pursuing this ambition, both projects face the same two-sided problematic, related to (1) the intrinsically volatile and distributed generation of renewable energy and (2) the inherent variability of residential and industrial energy consumption. The key challenge is to bring electricity production and consumption, each with its own internal complexities, into line with each other.

To this end, both projects rely on massive efforts of data generation and data analysis. iSMART, on the one hand, involves the digitisation, monitoring, and visualisation of individual electricity consumption, the quantification and monitoring of residential photovoltaic power generation, and the study of customer perceptions and uses of smart metering techniques (Kaegi et al, 2011). The three fields of reality thus decoded are combined through data analytics. For example, project participants can monitor in real time how much and what type of energy they consume and how much money they save by adjusting their energy use according to the availability of specific energy sources. Furthermore, iSMART relies on interviews conducted by BKW with the project participants, an approach which permits the study of how customers relate to IT-mediated, personalised electricity management. Thus the pilot not only tests the particular modalities and logics of techno-mediated regulation implied by current smart-city developments, but also investigates how these modalities and logics of regulation can be adapted to, negotiated with, and coproduced by the actual consumers of the service provided. Here, techno-mediated regulation positively embraces the needs and behaviours of the individuals who voluntarily participate in the control and management apparatus which emerges from it. As one of our interviewees from the BKW puts it,

> "Our primary concern [in the project] was to understand customer behaviours and preferences. How is energy saved, how is energy consumption shifted to other sources of energy, and what happens then?" (BKW corporate developer 2).

Flexlast also implies a form of governing through interrelation, aiming to optimise the balance between energy needs in refrigerated warehouses, the availability of solar and wind energy, and the overall stability of the grid. To this end, the project combines warehouse sensor data, along with data supplied by Migros's logistics and scheduling systems, real-time energy data from BKW and Swissgrid, and even weather forecasts (Glick, 2012; IBM, 2012). The aim is to keep the warehouses at the correct temperature whilst increasing the use of renewables and taking into account energy needs that are dependent on warehouse logistics (for example, open doors for the delivery of goods, building maintenance, and employee schedules). Furthermore, since warehouses functioning as thermal storage facilities can conserve energy and release it into the grid, the project is able to use them as a buffer to help balance fluctuations in the availability of solar and wind energy (Bundesamt für Energie, 2012, pages 6–7; IBM, 2012). Governing through code in the case of Flexlast thus aims to optimise the interplay between the individual scale and energy needs of the warehouse on the one hand and the collective scale and needs of the electricity grid on the other; both are approached as flexible variables with their own internal normalities and acceptable limits.

Resonating with Foucault's conceptualisation of security, both projects approach reality as an ensemble of intelligible and analysable components understood as the basic entities and conditions of optimised electricity management. Although the level of the singular is instrumental in this apparatus of power in that it forms the starting point from which explanatory patterns (normalities) are derived through data analytics, it is not the referent object of regulation. The key question is this: how can electricity consumption on

the household and industrial level, with its internal complexities, regularities, effects, and problems, be taken into account within, and in interaction with, the wider context of grid stability, increased use of renewable energy, and customer needs and preferences?

Automated and anticipatory governmentality

The regulatory dynamics that characterise iSMART and Flexlast imply eo ipso a mode of regulation that aims at the ever more intensive and extensive study of reality, to decipher its internal regularities. We thus find a combined reflex towards ever more increased data gathering and ever wider circuits of data flow. As noted by one of our interviewees from IBM, involved in the planning and development of Flexlast,

> "Wherever there is data, there is also software for data analytics. There is a clear trend to process ever more data through software and to interconnect ever more systems, ever more widely. Before, there used to be single systems, whereas today, optimisation is based on system integration" (Business Development Executive, Smarter Energy, IBM Switzerland).

Yet while data processing and management are at the very core of iSMART and Flexlast, both projects, ultimately, strive towards the software-driven automation of electricity management. The following quote illustrates this.

> "Putting great effort into operating my dishwasher at night, buying special light bulbs, etc, I may save 10, 20, perhaps 30 Swiss cents a day. That's obviously quite an effort for a small outcome. … That's when we naturally come to say, 'all of that has to be managed automatically'" (BKW corporate developer 2).

In referentiality terms, the dynamics of automation inherent in contemporary governing through code is of central importance and requires some further elaboration. Thus below, we discuss in more detail the power dynamics and implications of the increasingly automated governing of everyday life by smart technologies such as those highlighted in our two case studies. In so doing, we move beyond Foucault's conceptualisation of security, which, given the time at which it was written, does not take into account such developments (Graham, 2005; Kitchin and Dodge, 2011; Thrift and French, 2002).

Whilst automation is relatively modest in the case of iSMART—it is limited to the heating of residential hot water tanks depending on electricity demand—it is far-reaching in the case of Flexlast. The challenge here is to model and predict the warehouses' power requirements at any given time, taking into account warehouse characteristics, expected logistic activity, and other variables, thus allowing reduced energy consumption or activating reverse electricity flows during periods of either high demand on the grid or low availability of renewable energy. Drawing upon various grid-relevant and warehouse-relevant data sources, the project elaborates computer algorithms that serve as analytical and predictive tools to calculate and model both the potential for and the necessity of peak levelling.

In different ways and at different levels of complexity, both iSMART and Flexlast thus imply a relationship with reality that is at once calculated and calculating. There are two main implications to highlight here. Firstly, automated governing through code induces a temporal dynamics of regulation in which the relationship between past, present, and future manifests itself in a specific way: governing relies on predefined codes, derived from the analysis of the past and applied to the present, to anticipate the future (Klauser and Albrechtslund, 2014). As stated by Thrift and French, "software is deferred. It expresses the co-presence of different times, the time of its production and its subsequent dictation of future moments" (2002, page 311). Algorithmic governmentality is also, fundamentally, anticipatory governmentality (Amoore, 2007; Budd and Adey, 2009).

Secondly, governing through code is inherently performative in its relationship to reality. Computer algorithms constitute not only a tool of analysis but also a grammar of

action (Galloway, 2004; Kitchin and Dodge, 2011). As a model and technique of analysis, they simplify reality into a legible order (Budd and Adey, 2009, page 1369); as a means of automated response, they perform the future through this order. Governing through code is produced by and in turn produces specific classifications and orderings of reality.

One of the important questions that arise here relates to the adequacy of software to approach and govern the internal complexities and dynamics of reality. As Budd and Adey have argued, "whilst the relationship between software and the simulations they enable is often less than clear, the practice of using models and simulations is often constrained by the computing tools and languages in which they were written, limiting their accuracy and potential application" (2009, page 1370). Future research should provide more detailed empirical evidence with regard to how exactly contemporary smart-city initiatives aim to address this issue, and the wider implications this has for everyday social life.

Governing through code in its relation to normalisation

In our discussion of iSMART and Flexlast thus far, we have emphasised the reality-derived and relational mode of normalisation that characterises the two projects. To further develop this discussion of how governing through code relates to normalisation (normativity axis), we will take up and empirically address the three (processual, flexible, and contextual) normative logics of Foucauldian security that we outlined above.

In the iSMART project, normative targets for modified energy consumption are set, refined, and continuously readapted by each participant individually, depending on specific household conditions, goals, and progress made at any given time. In line with these moving, flexible, and differential targets, participants can choose and schedule when to purchase what kind of electricity and at what price. The system in turn assesses whether targets are met and visualises success, using a traffic light system (red for missing targets, orange for meeting targets, and green for exceeding targets).

This inherently processual and flexible self-management approach resonates with the now myriad gadgets and applications used by individuals for tracking, quantifying, and documenting various aspects of everyday life for purposes of self-surveillance and self-optimisation [for a wider discussion of contemporary self-tracking applications, see Albrechtslund (2013); Klauser and Albrechtslund (2014)]. Offering advanced possibilities for analysis, predictions, and recommendations, such tools and services are often framed in terms like 'a good life', 'sustainable lifestyle', 'healthy living', and 'individual responsibility'. Importantly, as in the case of iSMART, individuals are free to decide if and how they want to participate. Yet this freedom to decide is informed and governed on many levels and in all kinds of ways as the following quote shows:

> "Our key question is, 'how can we encourage people to change their behaviour?' … Energy costs are low, and will probably remain low, in comparison with health costs, etc. But there are other incentives [than financial ones]. What if you are awarded a traffic light colour as feedback? One minute you're red, [lagging behind] your neighbour; the next you may be orange or green …. That's motivating. Such questions are important. I don't think this [energy consumption] can be steered through financial incentives only" (Business Development Executive, Smarter Energy, IBM Switzerland).

The traffic light system and financial incentives mentioned in the quotation above are just two of the regulatory mechanisms associated with iSMART; other ways in which the project guides the participants' energy consumption include information campaigns, advice generated by software or solicited from customer advisors, and techniques such as apps that simulate alternative energy models or measure the energy consumption of specific appliances.

Together, these mechanisms form a mode of regulation that does not work in a disciplinary way (through rigid prohibitions or prescriptions), but that plays on the customer's desire

to optimise his or her electricity consumption. Many of these techniques indeed blur the traditional supplier–customer binary in that they depend on the active involvement of the customer, thus favouring and inciting a constant interaction between supplier and customer.

Through iSMART, the BKW's interview-based study of customer preferences goes yet one step further, in that it allows the company to study exactly how customers perceive the system, which in turn helps rework the conditions and framework within which self-governing is allowed to develop. iSMART, in this sense, also aims at the fine-grain adjustment of the fixed parameters within which the interplay of energy availability and consumption can be optimised. Mirroring security's relationship to normalisation, iSMART is not only processual and flexible, but also inherently contextual in function and scope.

Flexlast also implies a processual, flexible, and contextual logic of normalisation, although the three aspects are articulated in a different way. Firstly, we find again the idea of permanent optimisation, as expressed powerfully in the following quote, relating to the project's smart grid component:

> "Smart grids are subject to continuous improvement, which means technology never stops evolving. We're not saying 'smart city'. We say 'smarter city', which is a process. Getting smarter implies an evolution. One is never 'smart' and one would never have a 'smart grid'. Rather, one is at different stages of this evolution. What matters is to inject ever more intelligence, managing ever more consumers; all these elements are part of the equation" (Business Development Executive, Smarter Energy, IBM Switzerland).

Thus the ambition of Flexlast is not to achieve and then to conserve a perfect reality. Rather, the stated goal of injecting ever more intelligence implies a continuous regulatory dynamics, based on ever more complex calculations and modelling, considering ever more parameters and bringing together ever wider circuits of information flow.

Secondly, and as expressed by its name, the key ambition of Flexlast is flexibility. Using the thermal buffer potential of the warehouses, the project aims to enable more flexible adjustment of electricity demand and supply in a context of imbalance due to increased use of renewable energy. There are two levels of flexibility to highlight here. On the individual level, the buffer potential allows for more flexible management of the warehouses' air-conditioning demands. On the collective grid level, the buffer potential offers flexibility to compensate for the variations caused by the inflexible components of the system. Mirroring Foucauldian security, both levels allow for the matching of supply and demand within a flexible "multivalent and transformable framework" (Foucault, 2007a, page 20).

Thirdly, Flexlast also implies a contextual logic of normalisation in that it entails the establishment and recognition of those conditions and limitations of the energy system, imposed by nature, technology, political will, etc, which provide the basic parameters within which the interplay between electricity consumption and production can be optimised. Examples include the pregiven characteristics of the electricity grid, the relative inflexibility of warehouse logistics, specific temperature requirements for particular products, and all kinds of political stipulations and industrial regulations. This of course raises the important question of who fixes these (legal, material, technological, political, etc) conditions—ie, who has the authority to set the 'disciplined context' that circumscribes the field of intervention 'offered' to governing through code? We address this problematic in more detail elsewhere (Söderström et al, 2014).

In sum, both iSMART and Flexlast thus combine two interdependent regulatory regimes in normativity terms. On the one hand, the two projects imply a normative logic of governing that is fundamentally processual and flexible in its functioning, aiming to optimise the interplay between energy supply and demand, rather than to prohibit or to prescribe in rigid and predefined ways the use or supply of electricity at a given time. On the other hand,

on a contextual level, governing through code as illustrated by iSMART and Flexlast also implies a disciplinary logic of governing that aims at fixing those parameters within which flexibility is administered and encouraged.

Governing through code thus works through techniques of calculation that not only aim to decipher and align the internal complexities of interrelating fields of reality, but also help ascertain the limits within which the system is confined. The notion of the 'acceptable', acknowledged and calculated in both projects with regard to, for example, customer preferences, logistical needs, and political stipulations, testifies to this problematic. Importantly, this notion also lies at the very heart of Foucault's conceptualisation of security:

> "Instead of a binary division between the permitted and the prohibited, one establishes an average considered as optimal on the one hand, and, on the other, a bandwidth of the acceptable that must not be exceeded" (Foucault, 2007a, page 6).

It thus appears that both iSMART and Flexlast are shaped at their very core by the search for the right balance between flexibility and fixity—ie, between security and discipline. This also means that the regulatory logics of the two modes of power are not antagonistic, but embody and nourish each other (Foucault, 2007a, page 107). As Foucault puts it, "control is no longer just the necessary counterweight to freedom … : it becomes its mainspring" (2008, page 67).

Governing through code in its relation to space

As shall be shown in this third analytical section, relating to how governing through code relates to space (spatiality axis), iSMART and Flexlast both pursue a "spatial problematic of circulation", which again resonates strongly with Foucault's security (2007a, page 11). There are at least four elements that substantiate this claim.

Firstly, the spatial problematic of circulation inherent to both projects refers to the aspiration to "get the grids fit for the future", as one of our interviewees from the BKW puts it. This involves, more specifically, an ambition to (1) optimise the fluidity and efficiency of the electricity grid—ie, to better target and balance electric power transmission and distribution in order to avoid overloads or redundancy, (2) facilitate the connection between points of power generation and consumption, and (3) automate the management of energy flows whilst taking into account the specific needs that characterise both offer and demand, on the basis of increased digitisation, analysis, and software-driven modelling and prediction.

Secondly, both projects aim at a more widely distributed network structure, by integrating additional, decentralised energy feed-in points for purposes of increased grid stability and flexibility. Whilst iSMART incorporates additional photovoltaic installations on rooftops to meet electricity demand at the local level, Flexlast allows reverse energy flows from warehouses to feed into the regional grid. In both projects BKW praises the increased role of 'prosumers' [producing consumers—see McLuhan and Nevitt (1972)] in the elaboration of more flexible energy generation and consumption models (BKW, 2011, page 18).

Thirdly, in developing novel solutions for bidirectional energy flows on the electricity grid that favour decentralised energy sources, both projects also convey an ambition to differentiate and to positively or negatively discriminate varying sources and flows of energy, some of which are facilitated and endorsed, whilst others are considered less attractive and are gradually reduced.

Fourthly, the problematics of circulation inherent to iSMART and Flexlast also relate to data transfer and communication, as the correlative of the complex organisational and spatial structure of the grid. More specifically, iSMART involves two-way communication between smart meters and home appliances, and between households and BKW's central communication system, as well as subsequent data procession and transfer to web-based mobile devices that allow customers the remote and mobile monitoring and control of their

electricity consumption. Flexlast, in its smart grid dimension, also involves a complex architecture of data transfer and data integration, with a view to the automated management of electricity flows to and from the warehouses.

> "On the one hand, there is the energy grid; on the other, there is the infrastructure for data transfer. When I need information about the grid, I have to connect specific points of measurement so that they can communicate with each other. I also need to transfer the hence generated data to the BKW or elsewhere via the internet or the telephone network. That's why we use the existing telecommunication network" (BKW corporate developer 1).

In sum, both iSMART and Flexlast aim to allow more widely distributed, bidirectional energy flows, to better cope with the complexity of the energy system in a context of increased use of renewable energy. This ambition implies a regulatory apparatus that starts from the decoding of the governed flows—with regard to their multidimensionality (differing normalities in terms of availability and demand), distributedness (interacting sites of energy consumption and production), and multiscalarness (intertwined individual and infrastructural logics and needs)—with a view to their optimisation through internal adjustment and external enlargement.

Thus, both projects also exemplify the increased possibilities that now exist for interconnecting data sources situated on multiple geographical scales, and for processing and analysing in increasingly automated ways the data thus generated (Giffinger et al, 2007, page 10; Hollands, 2008). What we see emerging here is a form of geographically, socially, and institutionally distributed agency with regard not only to who generates energy, but also to who can access the data fused and interconnected within the complex 'surveillant assemblages' (Haggerty and Ericson, 2000) underpinning smart electricity management.

We thus find a spatial dynamics that responds to the need to manage and optimise circulations, rather than fixing and enclosing particular places, people, functions, and/or objects. Foucault, in his conceptualisation of the apparatus of security, grasps the spatiality of this kind of surveillance with unequivocal clarity:

> "The problem is not only that of fixing and demarcating the territory, but of allowing circulations to take place, of controlling them, shifting the good and the bad, ensuring that things are always in movement, constantly moving around, continually going from one point to another, but in such a way that the inherent dangers of this circulation are cancelled out" (2007a, page 65).

Conclusion

Our analysis of iSMART and Flexlast in terms of referentiality, normativity, and spatiality highlights a number of crosscutting and interdependent characteristics that define the power dynamics of contemporary governing through code. As we have shown, both iSMART and Flexlast imply a constant process of optimisation, aiming to adjust the balance between electricity consumption and production within the limits of the acceptable. Thereby, the aims and conditions of governing are constantly readapted and redefined, depending not only on the ever-changing parameters of the governed spaces of flows themselves, but also on the shifting context and conditions of regulation (such as cost calculations, public opinion, and availability of novel control techniques). The regulatory regime hence emerging relies on a mode of normalisation that is not only derived from reality, relative and plural in scope and scale, but also fundamentally flexible in its aims and functioning. Spatially speaking, iSMART and Flexlast accommodate a range of intersecting efforts which aim to manage energy consumption and production as an ensemble of increasingly interconnected, digitised, and 'technologically empowered' (IBM, 2010) systems of connections, processes, and flows.

Importantly, as we have shown, flexibility and interconnectivity are also at the very heart of Foucault's conception of security. This concept, we believe, thus offers a promising tool for the study of the aims and rationalities of power in action in the present-day world of IT regulation and mediation.

By way of conclusion, it is worth highlighting at least four major academic debates, regarding the making, functioning, and implications of contemporary smart-city initiatives, to which our analysis and conceptual focus contributes. In doing so, we aspire not only to reiterate the relevance of the analysis suggested in this paper, but also to indicate a series of highly profitable avenues for future investigation.

Governing through code and the everyday

In recent years a range of scholars have highlighted the power issues and implications of software-mediated regulation and control of urban systems (Graham, 1998; 2005; Kitchin and Dodge, 2011; Thrift and French, 2002). This research has shown that contemporary governing through code, whether aiming for greater efficiency, convenience, or security, is never neutral. The codes deployed enable and depend on novel forms and possibilities of differentiation and prioritisation used to assess and orchestrate everyday life and affecting the life chances of individuals or social groups in ways that are often unknown to the public.

However, despite the wealth of insight provided by recent research on the power implications of contemporary 'techno-politics' (Mitchell, 2002), a more systematic and truly empirical engagement with the inherent logics of software-mediated regulation has only just started to emerge (Kitchin and Dodge, 2011). The Foucauldian focus and case-study approach adopted in this paper contributes to this lacuna. In exploring the rationalities of power that characterise contemporary governing through code, we hope to have shed light on how software shapes everyday life in the information age.

Governing through code and economics

There are also extensive literatures emphasising the correlation between IT developments and economic transformation. As Manuel Castells puts it, "the information technology revolution was instrumental in allowing the implementation of a fundamental process of restructuring of the capitalist system from the 1980s onwards" (1996, page 13). Also consider Stephen Graham's claim that "the predominant dynamic of contemporary software-sorting innovations seems to be linked closely to the elaboration of neoliberal models of state construction and service provision" (2005, page 565).

Our Foucauldian approach offers a specific take on this problematic. As we have shown, Foucault's investigation into historically situated apparatuses of power contains a key interest for the history of economics (2007a, page 2). Security, as mentioned before, is for Foucault intrinsically related to Western liberalism (2007a, page 48). If we accept this stance, our main claim (relating to the adequacy of Foucault's security for an understanding of the regulatory dynamics implied by current smart-city initiatives) by definition touches on the question of how contemporary governing through code relates to liberalist governmentality. The paper thus offers a way of pursuing Castells's and Graham's claims from a viewpoint centered on the actual power dynamics inherent in contemporary techno-mediated modes of governing.

Governing through code and urban policy mobilities

In its Foucauldian approach, the present paper locates the smart-city problematic within the wider context and history of differing techniques and rationalities of governing in the Western world. More specifically, by positing Foucault's security as the basic prism through which to explore contemporary governing through code, the paper invites the reconsideration—and to some extent the relativisation—of the originality and distinctiveness

of contemporary smart-city policies from the perspective of their constitutive regulatory logics and power dynamics.

Applied to the overall problematic of our research project—which also highlights the distinctly 'utopianist' marketing campaigns and ambitious initiatives run by IT companies such as IBM in an effort to establish themselves as obligatory passage points in the making of the 'smart city' as a novel urban policy model for the future (Söderström et al, 2014)—these considerations raise the question of what exactly is new in contemporary smart-city policies, and more specifically of what exactly technology companies add to the inherent rationalities of contemporary governing through code.

Governing through code and surveillance

As David Lyon put it in a recent conversation with Zygmunt Bauman, "it is crucial that we grasp the new ways that surveillance is seeping into the bloodstream of contemporary life and that the ways it does so correspond to the currents of liquid modernity" (Bauman and Lyon, 2013, page 152). This claim brings to the fore one of the most fundamental conceptual challenges for the study of how contemporary 'surveillant assemblages' (Haggerty and Ericson, 2000) orchestrate everyday life: namely, the need for further and more systematic conceptualisation of the immanent 'liquidity' and 'flexibility' of contemporary governing through code (also see Deleuze, 1992).

As we argue in this paper, Foucault's security offers a promising conceptual tool and framework for any such endeavour. It is in this sense that the present paper also contributes to an understanding of how surveillance (and indeed power more generally) works today, how and through what it is exercised, and what it produces.

Acknowledgements. We are very grateful to the Swiss State Secretary of Education and Research for the research funding provided that allowed the development of this paper. Furthermore, we would like to thank the BKW, and in particular Henrik Müller and Daniel Berner, for granting access to the iSMART and Flexlast pilots and for facilitating the interviews conducted with the project partners involved.

References

Albrechtslund A, 2013, "New media and changing perceptions of surveillance", in *Blackwell Companion to New Media Dynamics* Eds J Hartley, J Burgess, A Bruns (Wiley-Blackwell, Chichester, Sussex) pp 311–321

Amoore L, 2007, "Vigilant visualities: the watchful politics of the War on Terror" *Security Dialogue* **38** 215–232

Amoore L, 2009, "Algorithmic war: everyday geographies of the War on Terror" *Antipode* **41** 49–69

Bakıcı T, Almirall E, Wareham J, 2012, "A smart city initiative: the case of Barcelona" *Journal of the Knowledge Economy* **4** 135–148

Baudrillard J, 1994 *Simulacra and Simulation* (The University of Michigan Press, Ann Arbor, MI)

Bauman Z, Lyon D, 2013 *Liquid Surveillance* (Polity Press, Cambridge)

Bell S, 2012, "System city: urban amplification and inefficient engineering", in *Urban Constellations* Ed. M Gandy (Jovis, Berlin) pp 71–74

BKW, 2009, "BKW Group Annual Report 2009", BKW FMB Energy, Bern, http://www.bkw-fmb.ch

BKW, 2011, "BKW Group Annual Report 2011", BKW FMB Energy, Bern, http://www.bkw-fmb.ch

Bogard W, 1996 *The Simulation of Surveillance* (Cambridge University Press, Cambridge)

Boyne R, 2000, "Post-panopticism" *Economy and Society* **29** 285–307

Budd L, Adey P, 2009, "The software-simulated airworld: anticipatory code and affective aeromobilities" *Environment and Planning A* **41** 1366–1385

Bundesamt für Energie, 2012, "Flexlast: Erzeugung von Sekundär-Regelleistung durch ein dynamisches Lastmanagement bei Grossverbrauchern", annual report, http://www.bfe.admin.ch/php/modules/enet/streamfile.php?file=000000010956.pdf&name=000000290722

Bunnell T, 2004 *Malaysia, Modernity and the Multimedia Super Corridor: A Critical Geography of Intelligent Landscapes* (Routledge, London)

Castells M, 1996 *The Information Age: Economy, Society and Culture. Volume 1: The Rise of the Network Society* (Blackwell, Oxford)
Cost Action IS0807, 2008, "Memorandum of understanding" *Living in Surveillance Societies* http://www.liss-cost.eu/about-liss/description/
Crampton J W, Elden S, 2006, "Editorial: space, politics, calculation: an introduction" *Social and Cultural Geography* **7** 681–685
Crampton J W, Elden S (Eds), 2007 *Space, Knowledge and Power. Foucault and Geography* (Ashgate, Aldershot, Hants)
Deleuze G, 1992, "Postscript on the societies of control" *October* **53** 3–7
Dillon M, 2007, "Governing through contingency: the security of biopolitical governance" *Political Geography* **26** 41–47
Eger J, 2003, "Smart communities: becoming smart is not so much about developing technology as about engaging the body politic to reinvent governance in the digital age" *Urban Land* **60** 50–55
Elden S, 2001 *Mapping the Present: Heidegger, Foucault and the Project of a Spatial History* (Continuum, London)
Elden S, Crampton J W, 2007, "Introduction", in *Space, Knowledge and Power: Foucault and Geography* Eds J Crampton, S Elden (Ashgate, Aldershot, Hants) pp 1–16
Fischedick M, Lechtenböhmer S, 2012, "Smart City—Schritte auf dem Weg zu einer CO2-armen Stadt", in *Smart Energy: Wandel zu einem nachhaltigen Energiesystem* Eds H-G Servatius, U Schneidewind, D Rohlfing (Springer, Berlin) pp 45–61
Foucault M, 1977 *Discipline and Punish: The Birth of the Prison* (Pantheon, New York)
Foucault, M, 1982, "The subject and power" *Critical Inquiry* **8** 777–795
Foucault M, 2007a *Security, Territory, Population* (Palgrave Macmillan, New York)
Foucault M, 2007b, "The incorporation of the hospital into modern technology", in *Space, Knowledge and Power: Foucault and Geography* Eds J Crampton, S Elden (Ashgate, Aldershot, Hants) pp 141–151
Foucault M, 2008 *The Birth of Biopolitics* (Palgrave Macmillan, New York)
Franko Aas K, Oppen Gundhus H, Mork Lomell H (Eds), 2008 *Technologies of Insecurity* (Routledge, London)
Galloway A, 2004, "Imitations of everyday life: ubiquitous computing and the city" *Cultural Studies* **18** 384–408
Gandy O H, 1993 *The Panoptic Sort: A Political Economy of Personal Information* (Westview, Boulder, CO)
Giffinger R, Fertner C, Kramar H, Kalasek R, Pichler-Milanović N, Meijers E, 2007, "Smart cities: ranking of European medium-sized cities", final report, Centre of Regional Science, Vienna University of Technology, http://www.smart-cities.eu/download/smart_cities_final_report.pdf
Glick B, 2012, "Swiss consortium turns to business analytics to help build smart electricity grid" *Computer Weekly* 27 September, http://www.computerweekly.com/news/2240164018/Swiss-consortium-turns-to-business-analytics-to-help-build-smart-electricity-grid
Graham S, 1998, "Spaces of surveillant simulation: new technologies, digital representations, and material geographies" *Environment and Planning D: Society and Space* **16** 483–504
Graham S, 2005, "Software-sorted geographies" *Progress in Human Geography* **29** 562–580
Greenfield A, 2013 *Against the Smart City* (Do projects, New York)
Haggerty K, Ericson R, 2000, "The surveillance assemblage" *British Journal of Sociology* **51** 605–621
Hannah M G, 1997, "Space and the structuring of disciplinary power: an interpretive review" *Geografiska Annaler, Series B* **79** 171–180
Hardt M, Negri A, 2000 *Empire* (Harvard University Press, Cambridge, MA)
Hollands R G, 2008, "Will the real smart city please stand up? Intelligent, progressive or entrepreneurial?" *City* **12** 303–320
Huxley M, 2008, "Space and government: governmentality and geography" *Geography Compass* **2** 1635–1658
IBM, 2010, "Smarter cities with IBM software solutions", http://ftp://public.dhe.ibm.com/software/ch/de/multimedia/pdf/transcript-smarter-cities-with-ibm-software-solutions-eng.pdf

IBM, 2012, "Swiss energy utility and supermarket chain pilot smart grid using renewable energy", press release, http://www.zurich.ibm.com/news/12/flexlast.html
Jones R, 2001, "Digital rule: punishment, control and technology" *Punishment and Society* **16** 5–22
Kaegi E, Berner D, Peter A, 2011, "Flexible thermal load management for ancillary services market: experience of Swiss smart grid pilot project", Proceedings of the 21st International Conference on Electricity Distribution, Frankfurt, 6-9 June, http://www.cired.net/publications/cired2011/part1/papers/CIRED2011_0481_final.pdf
Kitchin R, 2013, "The real-time city? Big data and smart urbanism", paper presented at the 'smart urbanism' workshop at the University of Durham, 20–21 June, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2289141
Kitchin R, Dodge M, 2011, *Code/Space: Software and Everyday Life* (MIT Press, Cambridge, MA)
Klauser F, 2013, "Through Foucault to a political geography of mediation in the information age" *Geographica Helvetica* **68** 95–104
Klauser F, Albrechtslund A, 2014, "From self tracking to smart urban infrastructures: towards an interdisciplinary research agenda on big data" *Surveillance and Society* **18** 273–286
Komninos N, 2002 *Intelligent Cities: Innovation, Knowledge Systems and Digital Spaces* (Spon Press, London)
Langheinrich M, 2009, "Privacy in ubiquitous computing", in *Ubiquitous Computing* Ed. J Krumm (CRC Press, Boca Raton, FL) pp 95–160
Latour B, 2005 *Reassembling the Social: An Introduction to Actor-network-theory* (Oxford University Press, Oxford)
Lianos M, 2003, "Social control after Foucault" *Surveillance and Society* **1** 412–430
Lyon D (Ed.), 2003 *Surveillance as Social Sorting* (Routledge, London)
Lyon D, 2007 *Surveillance Studies: An Overview* (Polity Press, Cambridge)
McLuhan M, Nevitt B, 1972 *Take Today: The Executive as Dropout* (Harcourt Brace Jovanovich, New York)
Miller P, Rose N, 2008 *Governing the Present* (Polity Press, Cambridge)
Mitchell T, 2002 *Rule of Experts: Egypt, Techno-politics, Modernity* (University of California Press, Berkeley, CA)
Murakami Wood D, 2010, "Beyond the panopticon: Foucault and surveillance studies", in *Space, Knowledge and Power: Foucault and Geography* Eds J Crampton, S Elden (Ashgate, Aldershot, Hants) pp 245–264
Norris C, Armstrong G, 1999 *The Maximum Surveillance Society: The Rise of CCTV* (Berg, Oxford)
Philo C, 1992, "Foucault's geography" *Environment and Planning D: Society and Space* **10** 137–161
Söderström O, Paasche T, Klauser F, 2014, "Smart cities as corporate storytelling" *City* **18** 307–320
Streitz N, 2011, "Smart cities, ambient intelligence and universal access", in *Universal Access in HCI, Part III* Ed. C Stephanidis (Springer, Heidelberg) pp 425–432
Thrift N, French S, 2002, "The automatic production of space" *Transactions of the Institute of British Geographers, New Series* **27** 309–325
Thrift N, 2006, "Space" *Theory, Culture and Society* **23** 139–155
Townsend A, 2013 *Smart Cities* (W W Norton, New York)