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SMART CITY INITIATIVES AND THE FOUCAULDIAN LOGICS OF GOVERNING THROUGH CODE

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Recent urban policy debates have been heavily influenced by discourses reiterating the promises associated with 'smart' information technologies 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; Hollands, 2008; Bell, 2012; Kitchin *et al.*, this volume), 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. First, 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. Second, 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. Third, 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; see also Chapter 2, this volume).

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.

Resulting from a two-year research project focused on smart technology applications in the fields of traffic and electricity management, this chapter 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 relating to smart energy management in Switzerland (iSMART and Flexlast), the chapter 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 chapter 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).

To lay the grounds for this analysis, we first explain briefly the two case studies addressed in the chapter and then move on to outline in some more detail the conceptual approach pursued.

Empirical approach

The two smart-energy projects that will be explored empirically in this chapter are iSMART and Flexlast. 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: 33). As part of the project, 300 households in Ittigen – a municipality of 11,000 inhabitants, near the city of Berne – 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 Berne, 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.

Conceptual approach

The chapter adopts a Foucauldian conceptual approach to explore the power and regulatory dynamics inherent in contemporary smart city and smart infrastructure initiatives, as illustrated by iSMART and Flexlast. The main reason for this lies in Foucault's governmentality framework, which allows the study of differing apparatuses of power, understood as historically situated ensembles of techniques for organising and regulating the objects and resources of governing (Foucault, 2008: 186). In differentiating, for example, between juridico-legal, pastoral, disciplinary and security types of power, Foucault (2007) 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.

More specifically, we here retain in particular Foucault's conceptualisation of (the apparatus of) 'security' as opposed to 'discipline', as a conceptual tool that allows the emphasis and exploration of the intrinsic flexibility of contemporary governing through code (Bauman and Lyon, 2013), in its relation to reality, normalisation and space (Klauser, 2013; Klauser and Albrechtslund, 2014).

This focus is neither meant to imply that contemporary governing through code entails a strictly homogeneous range of techniques in terms of their regulatory logics, nor to suggest 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 chapter thus 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.

With this in view, 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 and people, 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 (2007: 12). Thus disciplinary normalisation consists in breaking down a given multiplicity into specific components, as both the locus and referent object of power put into action (2007: 56–7).

Security, in contrast, works on the relationship between components of a given reality, instead of focusing on the singularised entities separately (Foucault 2007: 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 – i.e. 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, pre-established normative model, whilst security proceeds from the internal, decoded 'normalities' of reality, with a view to optimising their interplay (Foucault, 2007: 63). In sum, the relationship of discipline to reality is singularising, essentialist and, in its derivation from a pre-given 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: first, 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 functions.

Second, 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 2007: 20).

Third, 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 natural processes that are granted freedom to evolve according to their internal logics and dynamics, within the acceptable limits of the system (Foucault, 2007: 45). For Foucault, security implies a certain level of freedom – broadly conceived as the 'possibility of movement' (2007: 48–9) – as its basic condition (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: 63–4). 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' (2007: 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: 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 (2007: 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, 2007: 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' (64). The aforementioned conception of freedom as the 'possibility of movement' (48–9) 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 pre-given raw material. The aim is to arrive at a point of perfection at which spatial organisation fully responds to, and in turn enforces, a pre-given optimal normative model (Foucault, 2007: 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: 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 (i.e. not necessarily co-located) 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 (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])*

This quotation, 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.

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: 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 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'.
>
> *(Interview, BKW corporate developer)*

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, 1998, 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 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. First, 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: 311). Algorithmic governmentality is also, fundamentally, anticipatory governmentality (Amoore, 2007).

Second, 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: 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: 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 (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 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, the next you may be orange or green …. That's motivating.
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> *(Interview, 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 advisers and 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. First, we find again the idea of permanent optimisation, as expressed in the following quotation, 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.
>
> *(Interview, 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.

Second, and as expressed by its name, the key ambition of Flexlast is flexibility. There are two levels to highlight here. On the individual level, the buffer potential of the warehouses allows for more flexible management of the buildings' 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, 2007: 20).

Third, 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 or political will, which provide the basic parameters within which the interplay between electricity consumption and production can be optimised. Examples include the pre-given 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 – i.e. 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, 2007: 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 – i.e. 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, 2007: 107). As Foucault puts it, 'control is no longer just the necessary counterweight to freedom … it becomes its mainspring' (2008: 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 (2007: 11). There are at least four elements that substantiate this claim.

First, 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 – i.e. 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.

Second, 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: 18).

Third, 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.

Fourth, 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.

In this sense, 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: 10; Hollands, 2008; see also Chapter 2, this volume). 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.
>
> *(Foucault, 2007: 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 heuristic tool for the study of the aims and rationalities of power in action in the present-day world of IT-mediated regulation.

We have looked in this chapter at small-scale initiatives because it is there we believe that the everyday logics of smart cities can be best understood. By approaching smart cities as 'governing through code', in referentiality, normativity and spatiality terms, we have both tried to provide an analytical frame for the study of present software-mediated forms of governing and suggested that whatever will come after smart cities ('supersmart' cities?) should be considered within a genealogy of such increasingly ubiquitous regulatory regimes.

Of course, there is much more to be done to sharpen and extend this interpretation. Also, it will be of major importance for future research to experiment with yet other conceptual vocabularies and perspectives, in order to grasp the complex power dynamics that characterise contemporary modes of governing through code. Such reflection is indeed fundamental, we believe, if we are to understand how smart technologies affect everyday life, or if we are to debate the opportunities and risks associated with the much acclaimed smart city.

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Note

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

References

Albrechtslund, A. (2013) New media and changing perceptions of surveillance. In J. Hartley, J. Burgess and A. Bruns (eds) *The Blackwell Companion to New Media Dynamics*. Chichester: Wiley-Blackwell, pp. 311–321.

Amoore, L. (2007) Vigilant visualities: the watchful politics of the War on Terror. *Security Dialogue* 38 (2): 215–232.

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

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

BKW (2009) *BKW Group Annual Report 2009* [online]. Available at: www.bkw-fmb.ch [Accessed 15 August 2014].

BKW (2011) *BKW Group Annual Report 2011* [online]. Available at: www.bkw-fmb.ch [Accessed 15 August 2014].

Budd, L. and 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* [online]. Available at: www.bfe.admin.ch/php/modules/enet/streamfile.php?file=000000010956.pdf&name=000000290722 [Accessed 15 August 2014].

Crampton, J. W. and Elden, S. (2006) Editorial: space, politics, calculation: an introduction. *Social and Cultural Geography* 7 (5): 681–685.

Crampton, J. W. and Elden, S. (eds) (2007) *Space, Knowledge and Power. Foucault and Geography*. Aldershot: Ashgate.

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.

Elden, S. (2001) *Mapping the Present: Heidegger, Foucault and the Project of a Spatial History*. London: Continuum.

Elden, S. and Crampton, J. W. (2007) Introduction. In J. Crampton and S. Elden (eds) *Space, Knowledge and Power: Foucault and Geography*. Aldershot: Ashgate, pp. 1–16.

Foucault, M. (1977) *Discipline and Punish: The Birth of the Prison*, New York: Pantheon.

Foucault, M. (1982) The subject and power. *Critical Inquiry*, 8: 777–795.

Foucault, M. (2007) *Security, Territory, Population*, New York: Palgrave Macmillan.

Foucault, M. (2008) *The Birth of Biopolitics*. New York: Palgrave Macmillan.

Galloway, A. (2004) Intimations of everyday life: ubiquitous computing and the city. *Cultural Studies* 18 (2–3): 384–408.

Giffinger, R., Fertner, C., Kramar, H., Kalasek, R., Pichler-Milanović, N. and Meijers, E. (2007) *Smart Cities: Ranking of European Medium-Sized Cities*. Vienna: University of Technology, Centre of Regional Science. Available at: www.smart-cities.eu/download/smart_cities_final_report.pdf [Accessed 15 August 2014].

Glick, B. (2012) Swiss consortium turns to business analytics to help build smart electricity grid [online]. *Computer Weekly*, 27 September. Available at: www.computerweekly.com/news/2240164018/Swiss-consortium-turns-to-business-analytics-to-help-build-smart-electricity-grid [Accessed 15 August 2014].

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 (5): 562–580.

Haggerty, K. and Ericson, R. (2000) The surveillant assemblage. *British Journal of Sociology* 51 (4): 605–621.

Hannah, M. G. (1997) Space and the structuring of disciplinary power: an interpretive review. *Geografiska Annaler – Series B* 79 (3): 171–180.

Hollands, R. G. (2008) Will the real smart city please stand up? Intelligent, progressive or entrepreneurial? *City* 12 (3): 303–320.

Huxley, M. (2008) Space and government: governmentality and geography. *Geography Compass* 2 (5): 1635–1658.

IBM (2010) *Smarter cities with IBM software solutions* [online]. Available at: ftp://public.dhe.ibm.com/software/ch/de/multimedia/pdf/transcript-smarter-cities-with-ibm-software-solutions-eng.pdf [Accessed 15 August 2014].

IBM (2012) Swiss energy utility and supermarket chain pilot smart grid using renewable energy [online press release]. Available at: www.zurich.ibm.com/news/12/flexlast.html [Accessed 15 August 2014].

Kaegi, E., Berner, D. and 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. Available at: www.cired.net/publications/cired2011/part1/papers/CIRED2011_0481_final.pdf [Accessed 15 August 2014].

Kitchin, R. and Dodge, M. (2011) *Code/Space: Software and Everyday Life*. Cambridge, MA: MIT Press.

Klauser, F. (2013) Through Foucault to a political geography of mediation in the information age. *Geographica Helvetica* 68: 95–104.

Klauser, F. and Albrechtslund, A. (2014) From self tracking to smart urban infrastructures: towards an interdisciplinary research agenda on big data. *Surveillance and Society* 18 (3): 273–286.

Latour, B. (2005) *Reassembling the Social: An Introduction to Actor-Network-Theory*. Oxford: Oxford University Press.

Lyon, D. (2007) *Surveillance Studies: An Overview*. Cambridge: Polity Press.

McLuhan, M. and Nevitt, B. (1972) *Take Today: The Executive as Dropout*. New York: Harcourt Brace Jovanovich.

Mitchell, T. (2002) *Rule of Experts: Egypt, Techno-Politics, Modernity*. Berkeley, CA: University of California Press.

Philo, C. (1992) Foucault's geography. *Environment and Planning D: Society and Space* 10 (2): 137–161.

Söderström, O., Paasche, T. and Klauser, F. (2014) Smart cities as corporate storytelling. *City* 18 (3): 307–320.

Thrift, N. (2006) Space. *Theory, Culture and Society* 23: 139–155.

Thrift, N. and French, S. (2002) The automatic production of space. *Transactions of the Institute of British Geographers* 27 (3): 309–325.