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Drone city – power, design and aerial mobility in the age of "smart cities"

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Abstract. This paper address the phenomenon of drones and their potential relationship with the city from the point of view of the so-called "mobilities turn". This is done in such a way that turns attention to a recent re-development of the "turn" towards design; so the emerging perspective of "mobilities design" will be used as a background perspective to reflect upon the future of drones in cities. The other perspective used to frame the phenomenon is the emerging discourse of the "smart city". A city of proliferating digital information and data communication may be termed a smart city as shorthand for a new urban condition where cities are networked and connected (as well as disconnected) from the local block to global digital spheres. In the midst of many of the well-known data-creating devices (e.g. Bluetooth, radio-frequency identification (RFID), GPS, smartphone applications) there is a "new kid on the block" that will potentially be a game-changer for urban governance, economics and everyday life. Here we are thinking of the unmanned aerial vehicle or drone as the popular term has it. Therefore, the paper asks how life in "drone city" may play out. Drones may alter the notion of surveillance by means of being mobile, as well as profoundly altering the process and perspective of data collection and feedback to governments, businesses and citizens.

1 Introduction

Contemporary digital communication technologies have changed the way we see, think and act within cities in fundamental ways during the last few decades (Graham and Marvin, 2001; Gordon and de Souza e Silva, 2011; van't Hof et al., 2011). The latest development in this technological trajectory is centred around databases with large data sets ("big data"), extreme computing power, lower costs for hardware and feedback systems of data that provide real-time information about almost anything, anywhere (Batty et al., 2012). The notion of "smart cities" reaches from corporate "off the shelves" systems, e.g. traffic surveillance from companies like Cisco, IBM or Siemens, to government surveillance and policing systems, to veritable proliferation of individualised and customised geo-locational services and facilities predominantly provided on smartphones and portable computer systems. The "smart city" discourse is at one and the same time a corporate buzzword, a governmental model, a service and commodity, as well as being an interface for citizens and communities across the world (Brynskov et al., 2012; Capelli, 2012; Hajer and Dassen, 2014). Increasingly the latter dimension where smart city technologies are put in the service of community empowerment is hotly debated and many examples proliferate where this seems to be rather successful. This trend does, however, seem to be more connected to apps and digital communication services such as location-aware systems on smartphones. Therefore, one key issue when looking at the emergence of drone technologies is whether they will also hold empowering potential for institutions other than states, government bodies, commercial enterprises and organised crime. The problem of regulating the "drone city" is probably going to be the key issue here since a city swarmed with privately operated drones seems like a scenario of little attractiveness; yet still the information potential of the hypermobile feedback systems relying on drones does seem attractive (or indeed unavoidable). At the end of this paper we return to such issues, but before that

we will explore an analytical framework for understanding the issues connected to life in the drone city.

2 Smart cities, feedback urbanism and drones

There is already vast literature trying to come to terms with the contemporary urban situation as one of increased mediation and that is highly influenced by the presence (and absence) of digital networked technologies. In this paper we cannot possibly deal with this literature in detail (see Batty et al., 2012), but the underpinning understanding of the smart city is based on research which sets up a vocabulary containing key terms like "net locality" (Gordon and Silva, 2011), "code/space" (Kitchin and Dodge, 2011), "digital ground" (McCullough, 2004), "decoding the city" (Offenhuber and Ratti, 2014), "splintering urbanism" (Graham and Marvin, 2001), the "militarization of urbanism" (Graham, 2010), and the "sentient city" (Shephard, 2011). The key feature from the smart city literature is (when it comes to technology) the capacity to harvest, store, analyse, and distribute very large amounts of real-time data in complex systems of variable accessibility. The term "feedback urbanism" will be used here as a shorthand for this predominant feature and complex dynamic. At the time of writing there are big challenges in relation to the environment, globalisation, unequal development, geopolitical conflicts and demographic shifts. The more serious part of the smart city agenda recognises these challenges and sees these new technologies as parts of the potential solution to such grave matters. In Hajer and Dassen's sobering words, "the future calls for smart urbanism rather than smart cities" (Hajer and Dassen, 2014:13). Offenhuber and Ratti summarize the situation in the following way:

> [The theory of] smart cities, both an academic and an engineering discipline, is advanced by systems theorists and companies such as IBM, Siemens, or Cisco. The concept of smart cities promises to improve the management of cities by making its infrastructures more adaptive – able to collect information about its own state and to regulate itself based on the state of the whole system. Finally, perhaps most fundamentally, the role of the citizens in the governance of cities has changed in important ways. The rise of social media led to new form of participation and social activism. Beyond traditional forms of participation in planning projects, citizens voluntarily fulfill increasingly sophisticated roles in monitoring, management, and governance of city and its infrastructure (Offenhuber and Ratti, 2014:8).

What emerges is a flimsy image of various agencies and stakeholders vesting and loading the smart city term with whatever seem opportune for their interests. In this respect the smart city discourse is no different from other times in the history of technology when divergent interpretations of the potential of technology are the order of the day. However, we want to zoom in, as it were, from this general level of discussion to one particular technology of the many within the smart city context, namely that of drones.

2.1 Drone usages and surveillance

From this contextualisation of the contemporary city being increasingly technologised and mediatised we will turn to a particular technology, namely that which in popular discourse has come to be named drones. Many experts resist this term due to its connotations of geopolitical conflicts where western states are utilising drones in the "war against terror" and where "killing at a distance" has been the most predominant imprint on the public debate. Here we want to focus on drone technology as a new dimension of real-time surveillance information in the contemporary city on a more general level. Needless to say, the ethical issues connected to drone technology do not go away simply because we turn to its domestication and naturalisation within cities that are not in war-like conflicts. Elsewhere this has been described in Michel Foucault's analysis of western governmental techniques and their testing in foreign contexts and the bringing back into domestic settings afterwards (Foucault, 2003). Foucault terms this a "boomerang" effect, and drone testing in war-ridden and geopolitical zones of conflict before they will appear as urban surveillance technologies in western cities may therefore be described as "Foucaultdian boomerangs" (Jensen, 2016).

Before embarking on more detailed discussion, let us, however, note how unmanned aerial vehicles (or drones) are defined by the British Ministry of Defence:

> An unmanned aircraft (sometimes abbreviated to UA) is defined as an aircraft that does not carry a human operator, is operated remotely using varying levels of automated functions, is normally recoverable, and can carry a lethal or non-lethal payload (British Ministry of Defence, 2011:1–2).

Here, as elsewhere, we shall define them as unmanned and remote-controlled flying devices capable of transmitting long-distance surveillance information, as well as carrying weapons (Jensen, 2016).

Drone applications have raised ethical and political concerns in relation to geopolitical aggression and the war against terror as well as the domestic use of drones for urban surveillance triggers public debates about privacy and civil rights, feeding a generally critical academic discourse (e.g. Chamayou, 2014; Finn and Wright, 2012; Goodman, 2013; Graham and Hewitt, 2012; Neocleous, 2013; Saif, 2014; Singer, 2013; Wall and Monahan, 2011; and Urry, 2014). The fact that we are looking at an aerial type of surveillance technology furthermore relates it to a notion of "air power" (Kaplan, 2006; Virilio, 1989) by means of the supremacy

gained from a privileged vertical viewing point (Gettinter et al., 2014). The notion of an all-seeing gaze of the state (Scott, 1998) or a panopticon of surveillance (Bentham, 1995) are relevant concerns. The worst-case scenario could then become one where "swarms of tiny, armed drones equipped with advanced sensors and communicating with each other, will thus be deployed to loiter permanently above the streets, deserts and highways" (Graham, 2010:xiii). What is at issue here is drone usage in non-combat contexts and what that might mean for the future life in drone city:

> The use of drones in non-combat settings may symbolically transform those sites to arenas of agonistic engagement and further militarise domestic police departments and government agencies to the detriment of individual liberties and the public good … bodies below becomes things to track, monitor, and apprehend, and kill, while the pilot and other allies on the network remain differentiated and proximate, at least culturally if not physically (Wall and Monahan, 2011:245–246).

Needless to say these are voices from the critical quarters of the academic community. There seems to be no doubt about the many applications and also that drone surveillance represents a huge leap in cost savings and humanitarian potential, for example in disaster zones. However, when it comes to imagining drones as a new dimension of urban surveillance there are reasons for critical and cautious reflection. It lies beyond the capacity of this paper to lay out the vast literature that is of relevance within surveillance studies, but drones and surveillance have been significantly addressed over the last few years (e.g. see Jensen, 2016; Greene, 2015; Klauser, 2013). Here we shall not report on these controversies in more detail but rather turn to the situational understanding of mobilities as a new and fruitful intersection with surveillance studies.

3 The "mobilities turn" – engaging situations and design

During the last decade or so, scholars within sociology, geography and other social science have started to pay particular attention to the way societies are better characterised by mobility, connections and networks than by static notions of societies as things. The so-called mobilities turn within social sciences thus turns to the mobility of people, goods, vehicles and information from the point of view that mobilities is much more than movement "from A to B". The mobilities turn has dedicated its research to explore the social, cultural, environmental, economic, political and technical dimensions of this increasingly mobile society (see Adey et al., 2014; Cresswell, 2006; Urry, 2000, 2007, 2014). The field is cross-disciplinary and reaches far into globalisation studies, migration studies, disability studies, tourism studies, technology studies and much more. Here we shall focus on the

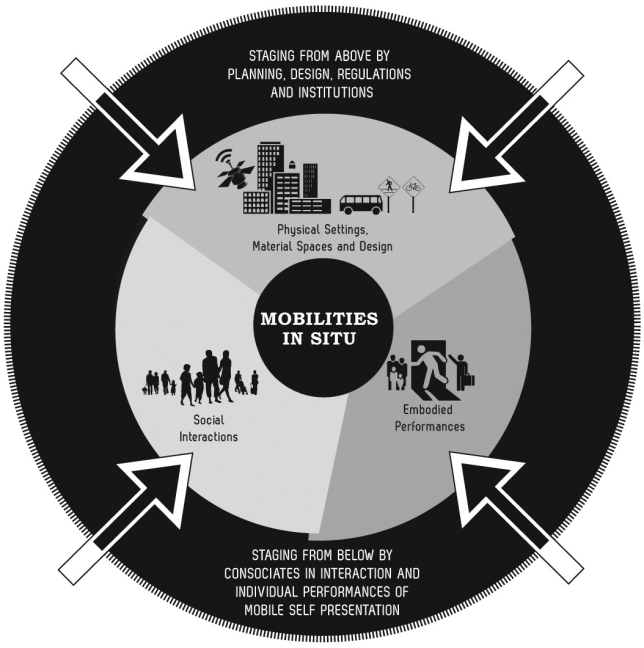

Figure 1. The Staging Mobilities framework (published in Jensen, 2013:6)

interface with design and architecture – a rather recent development within the mobilities turn. From the point of a situational understanding of mobilities, a new research agenda of "mobilities design" has emerged (Jensen, 2014). This perspective lends itself particularly well to exploring micro-level implications of mobile technologies and has, for example, been used to explore mobile phones in public spaces (Jensen, 2013). Here we shall aim to connect the detailed situational understanding of mobilities with the design questions, paving the way for an analytical model of surveillance dimensions to be developed at the end of this paper.

In this paper we shall focus on two particular points of value in applying the mobilities turn to the analysis of drones in cities. The first relates to the understanding of the mobile situation as such. In the Staging Mobilities framework (Jensen, 2013) mobile situations are understood as always materially dense, socially dynamic and acts of embodied performances. Furthermore, any mobile situation is "staged" from above through planning, regulation, design etc. as well being staged from below by humans and their practices (Fig. 1).

The framework for understanding mobilities in situ thus utilises the dramaturgical metaphor of staging as a way of understanding how mundane everyday life mobilities are dynamic and complex practices taking place in material sites and often complex infrastructures by and with people. The basic question is a pragmatic one: what makes this mobile situation possible? Asking this question on the basis of the Staging Mobilities framework leads to exploration of the interventions and decisions taken by designers, engineers,

architects and many others. The accompanying pragmatic question within mobilities design is thus as follows: what design decisions and interventions afford particular mobile situations? (Jensen, 2014). Therefore, equipped with the situational understanding of mobility and its intimate connection to design, we may start to go into more detail of particular relevance to drones and other mobile surveillance technologies. In relation to the situational model of mobilities analysis, one particular feature becomes detrimental. This is what we may term the situational "stretchiness" (Jensen, 2013). By this the changes from personal face-to-face distance, to communication through visual gestures within visual sight or shouting within ear's reach, to distantly mediated technologies like phones, internet and satellite supported communication are meant. What takes place is a transformation of the "proximity–connectivity nexus" through which senses of scale are altered. This is defined as follows:

> The proximity–connectivity nexus is the new dialectical and dynamic relationship between physical co-presence and mediated connections across time and space and how this affects mobile situations. Connections and distances have been influencing each other for a long time, but now the networked technologies … create a new and dynamic interface and mediation, or … a "nexus". This equals the distinction between topography (proximity) and topology (connectivity) (Jensen, 2013:136).

What is happening with the advent of digitally mediated technologies is that the former need to be proximate (close face-to-face distance) in order to connect (communicate) has been transformed into a situation where we "carry networks across time and space" (Jensen, 2013), thus "stretching" the situation as it were.

Smart city technologies interface with these new mediated situations at different levels, and drone technology offers a new highly mobile dimension of feedback communication. An example of the changed proximity–connectivity nexus through the use of drones is reported in an article in the journal *WIRED* by Allen McDuffee. Accordingly drones will, besides handling bombs and cameras, provide a new feature which has been explored by DARPA (The Defence Advanced Research Projects Agency of the United States Department of Defence). DARPA is now exploring how to utilise drones to carry mobile Wi-Fi hotspots with an equivalent of 4G smartphone connectivity to battlefields in remote areas where internet provision is bad or even missing. The drones will be providing troops with high-quality communication infrastructure in sites and zones where such features are missing (WIRED 15 April 2014). We may also think of real-time, drone-provided data in, for example, emergency rescue operations as an example of increased situational stretchiness where the altering of the proximity–connectivity nexus is the outcome. Therefore, the one main lesson from the situational mobilities framework is to understand the repercussions of drone technology on the changed dynamics and stretchiness of the situation.

The second main lesson to derive from the framing of the mobilities in relation to understanding drones as urban surveillance technologies connects to questions of design and architecture. Under the heading of mobilities design (Jensen, 2014), this theme throws light on the design decisions and interventions affording the mobile situation. All technologies affording contemporary urban mobile practices leave long traces in the design and architecture professions. The creation of the built environment facilitating urban mobility is a constant movement towards creating more efficient, safe, reliant, resilient and stimulating infrastructure channels and interchange hubs. For a long time, the application of CCTV, for instance, has been acknowledged as a more or less permanent feature of the built environment (from shopping malls to airport terminals to public spaces). In addition, the physical layout of buildings and urban spaces may lend themselves to low-tech surveillance. Here the most famous articulation of this principle is Jane Jacob's advocacy for "eyes on the street" as the most important and security-creating feature of urban spaces (Jacobs, 1961). In more specific terms relating to this paper, the advent of drones is expected to have repercussions for urban design, architecture and mobilities design.

One of the most imaginative articulations of these mobility design issues and their connections with drone surveillance comes from the design company Superflux Lab. In different art projects they explore the ramifications of drone technologies in the future urban landscape. The co-founder Anab Jain explains their work on the two projects Drone Aviary and Civic Objects in an interview with the web-based Center for the Study of the Drone in the following manner:

> The drone is a representation of a wider interest in thinking about how we might live with such technology in the near future … our intent is to raise questions about who owns airspace and what a civic space is when it comes to airspace. What are the infrastructural frameworks and networks that will need to be created for these drones to fly in cities? … We are interested in how as the network becomes physical, each drone becomes a node in the network, and suddenly the invisible network starts to become visible through these flying machines. Unlike buildings and roads and bridges, you're talking about no-fly zones, geofencing, and charging stations, none of which will actually be visible. But it's this sort of vertical geography, how do you dig into that, how do you design it, what is its relationship to the rest of our built environment. There are so many unanswered questions about this technology (Jain, 2015).

Despite the fact that some of the Superflux Lab projects have not materialised, the pertinence of the questions asked and the relevance of the public outreach through these art projects, installations, exhibitions and film is appreciated.

The invisible paths regulating drone mobility are like the fly routes organised and controlled for air traffic that we know. However, closer to the urban scale and even within buildings, urban flight paths for drones raise a number of issues. One, obviously, is safety, both in terms of drone versus drone (a proverbial set of traffic rules for drones), but also for humans and the environment, as crashing drones may create safety issues. Another issue is privacy. The company NoFlyZone (http://noflyzone.org) already offers protection against overflying drones. The system is very simple: one reports an address to the company website and when the drone manufacturer (and user) updates their software, the drone will automatically avoid entering such predefined no-fly zones. Important infrastructures such as airports and even the White House allegedly should be on the lists already. Surely these regulatory frames may be hacked, since a drone is basically a "flying computer" (Goodman, 2013). Some urban designers have started to speculate on how zoning and urban land use plans may look in a city of drones. This is for example the case with Mitchell Sipus who has developed a test scenario for three-dimensional drone zoning for Chicago (Spius, 2014). In relation to urban design, the drones in fact articulate the need for further three-dimensional understanding of cities, since many planners have perceived the city by and large on a two-dimensional surface (plan). With the advent of drones, the voids and volumes in-between the buildings become subject of a new spatial imagination which needs to be thought about both in plan (two dimensions) and section (three dimensions) in order to appreciate what Jain termed a "vertical geography". Here the bourgeoning insights from mobilities design seem to be obvious touchpoints if we are fully to understand urban drone surveillance. Rawn puts it as follows:

> In everything from the design of skyscraper facades with integrated drone landing pods, to invisible urban infrastructure for government zoning, to the nuanced design of private residences, it is clear that the technological revolution sparked by drones will have widespread architectural ramifications (Rawn, 2015).

The complexity of mobilities design reaches beyond traditional design disciplines and professions and into engineering, systems design, service design, and much more which is outside the scope of this paper. Next to pointing towards mobilities design, these issues also connect to discussions of volume, verticality and three-dimensionality within human and political geography (e.g. Elden, 2013; Klauser, 2010; Graham, 2016; Weizman, 2006). The theoretical and conceptual work of Elden is especially relevant here. As he asks what would happen if we move our conceptual understanding from area (two dimensions) to volume (three dimensions), he connects not only to the political and philosophical literature within human geography, but indeed also to key issues within mobilities design, with its focus on voids, volumes and materialities (Jensen, 2014). Elden uses the work of Sloterdijk to establish this connection and argues the following: "what is striking about Sloterdijk's work is the way that he tries to think space seriously as a volume, with three dimensions, rather than merely an area" (Elden, 2013:36). Such lessons of "volumetric thinking" connect very well to the mobilities design agenda, with one of its focuses being on learning from design and architecture. Besides creating connections across academic areas, the emergence of drone surveillance actualises a rethinking of cities and mobile situations. Here we use drone surveillance as a "prism" for this discussion. Put differently, drone surveillance pushes theoretical reflection in cities and mobilities towards what we would term three-dimensional thinking. This, however, is indeed a part of the architectural reflections within mobilities design.

We shall now move from the design discussion and into a first attempt to create a situation-based analytical framework for comprehending urban drone surveillance. This we will do by launching a model of six dimensions of surveillance.

4 Six dimensions of surveillance – towards a situational stratification model

What is unique about drones as new tools for urban surveillance? The main feature is that the sensor is mobile in itself and that this affords versatile real-time information gathering. This, however, also means that a drone within an urban surveillance assemblage contributes to a stretching of the mobile situation as we need to include the mobile unmanned aerial vehicle hovering above the situation on the ground. With this background we want to propose a first and rather tentative model of the stratifications or dimensions of surveillance that must be appreciated when investigating urban drone surveillance.

4.1 Dimension 1: Copresent humans

This is the most common of all surveillance situations and may be evident in the case of the police officer "on the beat" or the alert copresent citizen. At this level we are dealing with human–human copresent situational surveillance. The many accounts of shadowing within fiction and detective stories may also be thought of here. The key feature in this dimension is humans watching humans from equal viewing positions. In other words, we are dealing with surveillance conducted from the same vertical position.

4.2 Dimension 2: Eyes on the street

The second dimension is the classic community surveillance by concerned and engaged fellow citizens. We have named this "eyes on the street" in homage to Jane Jacobs (1961) who argued that shopkeepers and inhabitants of urban neighbourhoods actually are very important surveillance actors (Jacobs, 1961). We may think of the shopkeeper looking out the window or the people gazing out the window from above (in the latter case the privileged position comes from the vertical difference in viewing point and is thus an example of a static form of aerial viewing power).

4.3 Dimension 3: CCTV

The third dimension is simply termed CCTV after closed circuit television technology that has been the predominant form of urban surveillance technology in many cities across the world for many years. The most important feature in this context is that we are dealing with fixed sensors (cameras) connected to systems feeding situational surveillance information to either a remotely located human operator looking at a screen, or to social signalling processing (SSP) software and a database that sort and filter the data (SSP is an emerging field of research applying computer vision software for facial recognition, body language identification etc.; see Vinciarelli et al., 2009). The CCTV dimension of surveillance may thus rely on a human operator or they may be fully automated through systems of machine-to-machine communication.

4.4 Dimension 4: Digital network technologies

With the advent of smartphone technologies and portable computer power, the fourth dimension of surveillance deals with digital network technologies. Through the interface and enrolment in various networked systems (some of a voluntary nature, as when we download an application in order to experience a city as tourists), phones and computers are tracked through internet connections. We may however also include here more local types of digital surveillance such as Bluetooth-based sniffer systems, tracking phones with activated Bluetooth systems. Equally relevant for the fourth dimension are the digital traces left either when we visit websites leaving IP identification, or when we pass through the grid and cells of mobile communication systems (Wi-Fi or 3G/4G masts). Traces picked up through digital networked surveillance systems feed into databases often with large data sets, where it may take algorithms to establish identification and pattern recognition. The general feature here is again the static and fixed placement of the sensor infrastructure as well as the fact that there is an amount of machine-to-machine communication even if humans enter "the loop" at some point to access, analyse or make decisions in accordance with the data. The fourth dimension of surveillance may either rely on local infrastructure systems (e.g. Bluetooth sniffers, radio-frequency identification (RFID) or Wi-Fi) or it may rely on satellite communication affording and facilitating its operations.

4.5 Dimension 5: Drone surveillance

This brings us to the fifth dimension of this tentative stratification model. The unmanned aerial vehicles (drones) represent a mobile tracking and surveillance scenario, creating a very versatile and situational flexible surveillance system. A surveillance drone may either report real-time situational surveillance data to a remotely placed human operator, or it may feed data into a database system, applying social signalling software (as dimension three). Dimension five is similar to dimension four in that it relies on mobile sensors, but the surveillance technology itself is mobile and controlled (either by a human pilot or fully automated) in dimension five. This dimension represents the most complex and sophisticated surveillance situation of the six dimensions.

4.6 Dimension 6: Satellite surveillance

It should also be mentioned that there is a final type of mobile surveillance technology which is also defined by the sensor's own mobility. Here we are thinking of satellite surveillance. However, even though the details of satellite images are impressive, the versatile operation of a moveable drone close to an actual situation outsmarts the satellite surveillance technology in terms of agility and situational sensitivity.

A few remarks might be called for in relation to this stratification model. There are of course some commonalities across the dimensions of surveillance. For example we find big data and aggregated data present in dimension 3–6. Another thing is obviously that it is a tentative analytical framework whose applicability and usability for empirical research may still need to be tested. Moreover, there is an emerging trend of self-surveillance ("sousveillance") in which the subject self-engages him- or herself in self-monitoring practices. Such personalised uses of e.g. drone surveillance ("dronies" is the term for a mobile-drone-facilitated selfie) have also not been addressed in the model so far (this would surely be possible but lies outside the scope of this paper as the interest is in others' – systems or peoples' – surveillance interest). Additionally, we may note that the model is a heuristic tool based on the insights from the situational mobilities framework which has not been developed for drone analysis as such. Fourthly, and most importantly, the dimensions of the model are an abstraction and they may obviously all be found in one and the same situation, creating rather complex mediated situational dynamics. This is precisely the point with the terminology of dimensions. These are abstractions and we may imagine them being copresent within complex geographies of surveillance.

5 Concluding remarks and future perspectives

From this heuristic exercise in identifying different dimensions of situational surveillance, we may try to tie the threads together a bit. We saw earlier that the smart city or what we term here as feedback urbanism utilises the increasing amount of real-time information and may do so in various circuits of data circulation. Drone surveillance technology is obviously very utile in relation hereto. Secondly, we saw that the mobilities turn has the potential of offering us a vocabulary in which the situational dynamics of mobile practices are addressed. Furthermore, the link to mobilities design suggests that we need to pay attention to how technologies, as part of the material and three-dimensional context of social practices, may afford (or prevent) particular practices. The design decisions and interventions enrol as an actor into the situation in a network of things, people, buildings, volumes, infrastructures and more or less well-defined cultural scripts for the situation. With the notion of staging, we see that multiple everyday life situations are staged by systems and regulations, as well as by intentions and human affect. It is in this rather complex setting that any surveillance technology focusing on the actual situation must be comprehended. Here, we find different dimensions of human–human versus machine-to-machine interaction. Additionally there are differences in the physical "viewing position" which make a difference to the type of surveillance. Most predominant in this context is of course the actual technology; this paper's focus on drones has been a first attempt to understand how we may include a flying device far from the face-to-face level that we normally understand as a defining characteristic of the situation. The solution to this issue is found in the situational mobilities perspective with its notion of the proximity–connectivity nexus and its sensitivity to the stretchiness of the situation. The mobile drone is enrolled into the situation with significant effects for systems of surveillance that are of interest to city governance as well as to commercial actors, as well as for those who do not respect legal and regulatory frameworks, such as those involved in organised crime. Whether this technology is also advantageous for the "third sector" of the city, namely citizens within civil society, is a different question. In other words, are drones for civil society? Alternatively, are these primarily technologies for "seeing like a state" (Scott, 1998)? It is beyond doubt that drone data may be applied by communities and citizens but the question that defines this is ultimately one of regulation. Will citizens be allowed to utilise real-time drone surveillance data? For now this seems rather unlikely, at least if we are thinking of state sanctions and legal approval. However, there are many examples of empowering drone usage, as for instance when protesting citizens utilise drone surveillance to monitor and document police violence or excessive use of force. From media coverage of the riots at Taxim Square in Istanbul, Turkey, to eastern European urban protesters, to the recent Hong Kong demonstrations, drone surveillance has proved its potential in unmasking power abuse; especially the YouTube web channel "Truth Locator" has displayed numerous examples hereof.

Following from this, more research is to be done. One thing would be to criticise and refine the situational surveillance framework presented here. This may be done by adding new technological insight or by deepening the understanding of the relationship between the dimensions. In addition, empirical research exploring how drone data at the very practical level feed into situations is very important. This matches the necessity for more detailed, everyday-life-oriented ethnographies exploring the consequences of (drone) surveillance (see Green and Zurawski, 2015; Klauser, 2010). Here the mobile and situational ethnographical accounts seem an obvious research strategy to follow; and studies of professions relying on real-time drone data may be executed (e.g. police officers, paramedics or utility maintenance workers). For a while, however, we may have more difficulties in engaging with the non-professional use of drone data. One place to start developing this research may though be amongst the many recreational uses of drones, even though these are restricted from the dense urban settings that are ultimately of interest if the topic is urban surveillance systems.

As with the advent of any technology the presence of drones triggers a number of issues: are drones the future of urban information and surveillance infrastructure? Will drones patrol cities and urban neighbourhoods in the future? How will this be controlled and regulated, and what will such mobile surveillance mean for urban life? Will mobile drone surveillance be confined to state agencies, or will private businesses and citizen also be able to apply these technologies? With drones we are facing a highly flexible and versatile surveillance technology, which when applied to urban surveillance (and when social recognition software is provided), may become even more contentious. Already, the issue of CCTV systems applying social recognition software begs questions of how one becomes a person of interest and how particular algorithms verify identification and authenticity. Such power-technical questions will not become less important or complex with the addition of the "fifth dimension" of drone surveillance to future urban spaces. What happens with our cities if the fifth dimension of surveillance becomes institutionalised as a standard operation procedure of surveillance? Seen from the point of view of the state apparatus, this means new and unseen potential for crowd control and surveillance. Seen from the point of view of the citizen, this means the end of public space as we know it. One thing for certain, however, is that we have only seen the beginning of how drones may affect issues of power, design and aerial mobility in the age of smart cities.

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