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SMART URBANISM IN BARCELONA: A KNOWLEDGE POLITICS PERSPECTIVE

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Abstract

There is a risk in the 'Smart City' that plural forms of knowing the city become eclipsed by singular governance-oriented analyses produced through computational logics originating from undemocratic service providers. In light of this concern, this chapter considers three aspects of smart urbanism's knowledge politics: i) the role of urban agencies – or understanding smart urbanism as a situated, socio-material practice; ii) the agency of smart city technologies' materiality as well as the ownership and control of these technologies, and: iii) the political rationalities, values and assumptions embedded in smart city technologies' design and use. Drawing on these insights, this chapter analyses smart knowledge politics in Barcelona, where the 2015 Council elections replaced a market-oriented political leadership enthusiastically implementing the Smart City with a political leadership whose origins in social movements and citizen democracy made it deeply sceptical towards smart urbanism. We analyse how this opened up space for different approaches to using technology in the city while at the same time giving rise to materially very different kinds of smart knowledge configuring technologies emphasizing citizen participation and democratic control of knowledge production. Indeed, political rationalities

and smart knowledge configuring technologies intersected and co-evolved, rather than one informing the other unidirectionally.

START OF THE CHAPTER

"Everything flows through the data centre in the middle of the town. So, if I own that data centre, I've got everything. Literally every part of the town comes right through there … Sold to me by Hitachi … I am the State. I got it all … It's kind of a packaged deal. Not just energy, or transportation, or home, or health, or whatever. They're actually ready to do what looks pretty much like a city council campaign. You could actually run for office like this … What are the political implications when you've actually sold off control over your streets; when you've offshored it to Silicon Valley or wherever it goes? Have you thought through the political implications of that? It may look smart, but how smart is that move? What happens if the App is on strike, or removes itself? How do you get the App back? Can you buy it; can you legislate it; can you code it yourself? You're over a barrel sister! I'm a smart city but my brain is run in California. How is that supposed to work out? Look behind the beautiful façade!"
Bruce Sterling, cyberpunk, at the 10th International FabLab Convention in Barcelona[1]

1: INTRODUCTION

Bruce Sterling's quote vividly captures some of the knowledge politics involved in smart urbanism. Or at least, the concerns critics raise against the Smart City vision: the way urban processes are reduced to codified, inter-operable (and tradeable) information; whose processing through calculation and inference produces ostensibly authoritative knowledge about complex cities; and whose proprietary characteristics cedes power to 'smart city' service providers (Greenfield, 2012). At the same time, however, technological advances in sensors, data handling, internet platforms, ubiquitous computation, and ever more imaginative visualisation permits wider access to information about cities, and opens up the possibility for unprecedented citizen involvement in urban processes.

Barcelona was an appropriate place for Bruce Sterling to make his remarks. He did so on a conference platform which later that day saw then-Mayor Xavier Trias commit Barcelona to becoming a smart, self-sufficient city within 40 years (see later). Under Mayor Trias, the city government was working hard to promote Barcelona as a world-leading smart city, and with considerable success (Continente et al, 2016). A wide variety of smart city installations had been implemented; international smart city service providers were locating their business

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[1] https://www.youtube.com/watch?v=OYNaoMkY8qY&feature=youtu.be (posted 15/07/2014; accessed 30/09/2016)

operations into a test-bed district; and an ecosystem of smaller developers and start-ups were innovating smart Apps and other tools.[2] Work was underway to integrate this patchwork of smart city elements into what was called an "Operating System" (OS) for the city: the "essential hardware, software and data components that quietly sit in the background directing urban flows, providing shared languages towards interoperability across multiple infrastructures" (Marvin and Luque-Ayala, 2017: 1).

Then, in 2015, city elections provided a moment for recent shifts in the urban political landscape. The new Mayor, Ada Colau, took office with a vision rooted in citizen mobilisations, commons and collaborative approaches to urban experimentation, and prototypes for direct democracy. Her new party, Barcelona en Comú [Catalan for Barcelona in Common] emerged from a kaleidoscope of innovative practices carried by the burst of activism by the 15-M movement over the period 2011-15, and which emerged in response to the political and economic crisis triggered by the 2008 financial crash. Barcelona en Comú won 11 out of 41 seats, and operates within a minority government. Under this coalition, the smart city was no longer a priority. Technological sovereignty has taken its place within a broader agenda for more democratic urban developments. In the terms of the Introduction to this book, Barcelona has undergone a shift in political rationality: "particular ways of thinking about, calculating and responding to [urban] problems" (p.11). Propelled by changing realities in the city and the emergence of new protagonists brought forwards by the contradictions in those realities, contending political rationalities have had consequences for the design and implementation of digital knowledge producing techniques.

In this chapter, we look to Barcelona as a case study in the knowledge politics of smart urbanism. Barcelona helps us explore an issue central to this book, which is how "the political processes through which knowledge configuring practices and strategies for representing the urban fabric are assembled and institutionalized" (Introduction chapter, p.3). What is fascinating in Barcelona, and we suspect other cities, is how digital projects can be disrupted, reconceived and reclaimed – or complemented and replaced by new digital projects – through urban politics that interact across elite and grassroots settings, and in ways that suggest more plural and hopeful possibilities.

2: SMART URBANISM

The smart city is not a new response to urban development, but the latest in a stream of initiatives over the last half century to incorporate information and communication technologies into processes for knowing and governing cities (Marvin and Luque-Ayala,

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[2] See the listing of multiple smart cities project at the Ajuntament website smartcity.bcn.cat (accessed 18th October 2016)

2017). Often, the promise of such radical technological changes is to rationalise urban sociotechnical transformations, and the implication is that it risks entrenching a 'post-political', technocratic approach to the city (Swyngedouw, 2009). Critical urban scholars see in smart city visions and experiments the interests of a rather narrow neo-liberal agenda focused upon technological fixes controlled by coalitions of corporate actors and city elites (Greenfield, 2013; Kitchen, 2014). As such, cities cede authoritative urban knowledge production, which should be subject to democratic scrutiny, to commercially interested technology providers. In this line of argument, ownership and control of knowledge producing and urban governance technologies are key political issues (Feenberg, 1999). Yet, advocates argue that ceding authoritative urban knowledge production to private parties is a reasonable political arrangement if those commercially interested smart city service providers produce knowledge that improves urban performance for their public authority clients, and if citizens benefit from improved services and more efficient use of their tax contributions. In this controversy between advocates and critics of the smart city, knowledge politics emerges with regard to the ownership and control of the knowledge production apparatus, its credibility and its performance.

Advocates and critics alike tend to see smart city technologies as largely impacting upon cities, like an external force of change, for good or ill. Sometimes there is recognition that smart technologies are shaped by global social and technological processes, such as neo-liberal ideology, public research into computation and Big Data, the rise of Silicon Valley, or normalising digital cultures. These social forces are usually deemed so pervasive or powerful that, from the perspective of an individual city, they appear as all-determining (Jordan, 2008). However, there remains relatively little consideration for the way in which digital technology developments may take shape in specific socio-material urban settings. Urban actors and historical social and material heritage exercising agency – which we will refer to as urban agencies – over digitally-enabled ways of conceiving, knowing about and intervening in urban development tend to be overlooked or downplayed.

Indeed, grassroots initiatives have been developing alongside off-the-shelf packages for smart city services, for instance in the area of sensors and environmental information; a development which potentially opens uses of ICT for citizen-led urban governance (Tironi and Sanchez Criado, 2015; Gabrys, 2014). Arguably, more democratic control of smart city technologies, including the utilization of free and open software protocols, permits pluralistic values and assumptions to continually enter governance debates and deliberations (Kurban et al, 2017). Furthermore, whilst powerful market and ideological dynamics shape ICT developments into forms that centralise urban knowledge convenient to corporate and urban elites, the implementation of off-the-shelf packages requires adaptation to a particular city's characteristics (Kahn and Kellner, 2007). Global social forces are therefore always confronted with local dynamics, which therefore need to be taken into account to understand smart urbanism. Municipalities are also developing expertise in-

house, and working with grassroots groups, local businesses and larger providers to develop bespoke services (Luque-Ayala and Marvin, 2015; Hajer and Dassen, 2014). Recognizing urban agencies in smart city developments highlights that a much more hybrid, less monolithic smart urbanism is emerging, each nevertheless involving an inescapable knowledge politics.

Overlooking urban agencies in favour of focussing on global social and technological processes shaping smart technologies also obfuscates the agency of smart technologies' materialities themselves – rather than their ownership and control – in the production of knowledge for urban governance. As this book's introductory chapter argues: the production of knowledge is rooted not only in discourse but also in material epistemic technologies: material artifacts enacting and articulating certain ways of knowing the city. The realization of smart city's promises relies upon the production, analysis and integration of big and varied data-sets, produced by a plethora of sensors (including static devices embedded in city infrastructures and mobile devices carried by citizens), and run by computers and servers whose calculations produce representations (ideally in real-time) about different aspects of city performance. Knowledge is produced through networked platforms: city-dash boards, Apps, control centres, and other devices that enable people to know what is going on in the city and who can intervene to adapt behaviour accordingly. These devices may afford different kinds of human participation: the devices enact people and other things in certain ways (Tironi, 2015). Some smart-enabled interventions are highly automated, such as the optimisation of traffic systems, or the triggering of actuators linked to, say, irrigation of parks. In other cases, human users are required to respond to signals, nudges or incentives issued by the smart city system, effectively acting automatically if human response involves little reflection. And then there are smart services that invite more active deliberation and decision by 'smart citizens', particularly when platforms are open to adaptation, but nevertheless within an invited arena with designed parameters for participation (Vanolo, 2016; Kurban et al., 2017).

Knowledge emerging from smart technologies is not only political because this knowledge may play an active role in urban governance decision-making, but also because the process of knowledge creation inevitably involves making choices, an insight emerging from science and technology studies (STS; see Introduction chapter). Whilst there are distinct schools of thought, at its heart STS analyses how any 'techno-scientific' project intended to better understand and govern complex worlds, necessarily carries normative assumptions and values in its design and implementation (Jasanoff, 2004). The knowledge produced by a smart city project is constructed through the interaction of design choices, user practices, the platforms themselves and the agency of the material characteristics of the issue about which knowledge is being produced (Latour, 2005). In other words, knowledge production in smart platforms is a political process, involving multi-scalar negotiation, agreement and dispute about the implementation of smart city technologies. This effectively determines

what information is gathered, how knowledge is produced (as well as inevitable gaps and uncertainties) and interpreted, and then how these insights are represented as reliable knowledge for acting in the city (Matthewman, 2011).

From this short review, the following three aspects of smart urbanism's knowledge politics can be distilled: i) the critical role of urban agencies – or understanding smart urbanism as a situated, socio-material practice; ii) the agency of smart city technologies' materiality as well as the ownership and control of these technologies, and: iii) the political rationalities, values and assumptions embodied in their design and use. We will use these insights as a lens on Barcelona as a smart city in order to better understand the interrelation between smart knowledge configuring practices and shifting political rationalities.

3: BARCELONA: MOVING BEYOND THE SMART CITY?

Barcelona is often presented internationally as a pioneer in modern urbanism. The Cerdà plan extended (and liberated) the city beyond its walls in the 1860s in a way that became symbolic for modernisation (Aibar and Bijker, 1987). Soon after the walls fell, the city fortress was demolished in order to create space for a Universal Exposition in 1888 (and what became the Ciutadella Park). The Exposition showcased urban redevelopments and a modern city to over 2 million visitors. A second World's Fair was held on Montjuïc in 1929. Developments for this exposition, conceived as a further motor for city development, similarly produced important monuments to modernisation. This 'model' evolved fitfully over the years - an international projection of the city based in modernising district developments – and found spectacular expression with the Olympic Games in 1992, and a less successful attempt with the Universal Forum of Cultures in 2004 (Degen and García, 2012).

Implementation of the 'Barcelona model' (Ribera-Fumaz, 2017) always involved political controversy and social and economic struggle (Aibar and Bijker, 1987; McDonogh, 2011): between social classes, over space, in the priorities and directions for development, concerning rights to the city, contradictions between attracting inward investment and attending to neighbourhood needs, and, pertinent here, the selective use of technology and knowledge about the city. Confronting the models of Barcelona's urban elite is a grassroots history of working class struggle, neighbourhood and nationalist politics, and social movements, all of which have understood their city quite differently. These contentious histories provide an important context for appreciating the arrival of the Smart City in Barcelona, and an aspiration for technological sovereignty.

3.1 The smart city vision

The positioning of Barcelona amongst the vanguard of Smart Cities was attempted most explicitly and vigorously under the leadership of Mayor Trias (2011-15) (Continente et al, 2016). Trias's deputy mayor for Urban Habitat, Antoni Vives, and the department's general director Vicente Gaullart set about articulating and implementing the vision. Prior to entering public office, Vives and Gaullart had been co-founders in 2001 of the Institute of Advanced Architecture of Catalonia (IAAC), dedicated to propel research and education about bringing new technologies into urban spaces. Whilst drawing upon visionary ideas cultivated at IAAC, these smart city leaders capitalized on projects and skills already present in Barcelona. In doing so, they articulated and repackaged initiatives already underway in the city, attempting to re-orientate the city to their vision.

In terms of operations and strategies already present in the area, the city had in 1990 created the Municipal Institute for Information Technology (IMI – Institut Municipal d'Informàtica) as an independent municipal body providing IT services. Fibre-optic cable began weaving through the city from 1994, and the introduction of networked computing services promoted thereafter. In 2000, the previous city council had announced an ambitious plan to develop a Knowledge District in the Poblenou area. Informed by a second phase of regeneration planning after the Olympics, this relatively run-down and poorly-served district was earmarked for residential, educational and commercial developments. The objective was to turn it into an attractive site for international investment in a knowledge economy that would attract a high-skill workforce to the city, including the ICT sector (Leon, 2008). The district was called 22@ and a municipal company, also called 22@, was created to market and manage the real estate and infrastructure projects involved. International property developers and investment firms began investing in the buildings rising above the old factories, mechanics and artists workshops, and housing.[3] The Torre Llacuna towerbuilding iconic for 22@ was completed in 2003. The nearby Media-ICT building won the World Building of the Year award in 2011 (March and Ribera-Fumaz, 2014: 5; Continente et al, 2014). Local universities opened campuses in the district. Barcelona Activa, the economic development agency of the city council, turned its attention to high-tech start-ups and entrepreneurs, and opened offices and provided incubation space in the Media-ICT building.

Under mayor Trias, Barcelona committed to Open Data policy in 2011, and began providing citizens and businesses with access to some of the information gathered by the council about the city. The city was selected as the Mobile World Capital by GSMA in 2011, and hence hosted future Mobile World congress events as well as the Smart City Expo since the same year. These events brought business executives and urban policy-makers to the city. Moves were made to attract international smart city technology firms to locate their

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[3] Whose neglect had provided space for artists and creative collectives now being displaced by the room being made for knowledge industry (Martí-Costa and Pradel I Miquel, 2012). A local campaign to resist and moderate 22@ to local needs had limited success.

development operations in 22@. Strategic agreements were announced, for example, with Cisco, IBM, Schneider-Telvent, Telefónica, GDF Suez and others. Indeed, as the smart city vision developed, so 22@ became marketed as a campus for smart city developments (March and Ribera-Fumaz, 2014; Charnock et al, 2014).

Smart systems were in place, or being established, to monitor and control traffic, energy, water use in parks, waste collection services, social services, care for the elderly, public transportation, and so forth (Bakici et al, 2013; Kuyper, 2016). IMI and others were developing software systems for managing the accumulation of thousands of diverse of sensors (e.g. the Sentilo open-software platform). Leaders invited, and incentivized, technology developers to embed themselves in the city and conduct smart urban experiments. Local entrepreneurs and start-ups were encouraged to make use of the data and platforms that were emerging, and to participate in smart city projects (Capdevila and Zarlenga, 2015). The city announced ambitions to create a city Operating System that would interconnect information from across the multiplying sensor networks and data gathering platforms in different city administration departments, and hence boost the ability of city authorities to observe and manage their intelligent city in real time.

Intriguingly, Vives announced, and began implementing, a plan to open ten public digital fabrication workshops in each of the ten districts of Barcelona as part of the smart city vision. Inspired by a 'FabLab' model originating at MIT (and which IAAC had pioneered on its premises since 2006), these 'Ateneus de Fabricació Digital' were equipped with a suite of digital design and fabrication technologies that would allow citizens to train and experiment in the prototyping of physical objects, and to share designs, knowledge and collaborate digitally with similar workshops globally (Smith, 2015). A network of neighbourhood Ateneus was envisaged as part of the public infrastructure for the 21st century smart city. These production facilities were envisaged as enabling Barcelona to become more materially self-sufficient whilst competing in a more sustainable world: sustainable design knowledge will be traded globally, but physical goods were made (and remanufactured) in local circular economies (Diez, 2012). At the 10th FabLab convention held in Barcelona in 2014, Mayor Trias committed his city to making over half the goods its consumed locally within 40 years (the smart, self-sufficient city; see Guallart, 2014).

The ambition with the extensive portfolio of smart initiatives was to simultaneously attract and finance industrial development, such that Barcelona would become a global hub for the development of (exportable) smart city services, whilst modernizing the city itself for a smart citizenship – a citizenship comfortable using technology applications, responding to the data that they willingly contribute towards smart city services, but not necessarily demanding other rights and responsibilities. By July 2015, Fortune magazine was writing how Barcelona was 'the most wired city in the world' (Walt, 2015). The city regularly featured at the top of global rankings for smart cities and innovative cities.

And yet, throughout these developments, citizens of Barcelona were positioned as relatively passive beneficiaries of smart city developments: as users of the services provided, beneficiaries of the visionary developments, workers in the new sectors; but, apart from the tech entrepreneurs, citizens actively involved in initiating and shaping grassroots 'smart' developments were overlooked. Meanwhile, myriad contracts were struck with businesses to develop the technologies and services, and demonstration funds from the European Commission and elsewhere were used to help embed smart-devices in urban development. As Fortune magazine observed, "Discreet and largely unannounced, the changes in Barcelona have slipped by even observant residents … Yet the stealthy transformation is profound and potentially so sweeping that no one is sure where it will lead" (Walt, 2015). In fact, announcements were made, and marketed very professionally, but appeared to be addressed as much, if not more, to international audiences relevant to Barcelona's global position, than to local users of the new services.

3.2 Grassroots digital urbanism

Whilst the smart city was being embedded in bus-stops, lamp posts, refuse bins, mobility systems, and machine-readable databases, and whose sensors and actuators were being interconnected through a developing Operating System, another smart Barcelona was becoming increasingly vocal and active. The economic crisis signalled by the financial collapse of 2008, and whose political consequences overwhelmed Trias's predecessor, was now troubling his administration in turn.

Construction, housebuilding, and urban developments had fuelled much of the economic growth in Spain from the 1990s, until the bubble burst in 2008 (García, 2010). The exposure of Spain to the global financial crisis was exacerbated by an associated implosion of its property market. Many families were left unable to meet mortgage repayments and, by 2012, one household was being evicted every 15 minutes; even though there was little social support for the homeless, and with 3.4 million homes vacant (Romanos, 2013). The Platform of Mortgage Victims (PAH, La Plataforma de Afectados por la Hipoteca, formed in 2009) articulated moral outrage at this situation and mobilised it into effective practical action. In doing so, it became a citizen mobilisation significant beyond housing, in Barcelona and hundreds of other cities, and that joined a confluence of actions in energy, mobility, culture, urbanism, and communications arising from 15-M in 2011. In the streets, and through varied actions, a broader vision for democracy and urban governance began to be articulated that was quite different to Trias' smart urbanism, and political programmes to put the broader vision into effect were developed (Gutiérrez, 2017; Gonick, 2016).

PAH built a power base that enabled it to renegotiate housing contracts and debt repayments on behalf of individual members. PAH did this by reframing evictions as a systemic and institutional issue rather than an individual failing, and coordinated more conventional campaigning activities for housing reforms alongside its practical help and solidarity for individual households (De Weerdt and Garcia, 2016). Digital tools helped in the organisation and communication of this activity at scale: making decisions, operating transparently, sharing information, eviction alerts, and experience about legal and banking matters, and networking between neighbourhood associations, especially when the campaign moved rapidly and began to operate nationally.

Grassroots groups were developing initiatives in what was becoming known widely as the solidarity economy: loosely affiliated systems of cooperative production and consumption initiatives in areas as diverse as food, mobility, energy, culture, housing, and politics. A variety of digital tools and platforms were being developed by activist coders and grassroots groups for assisting and coordinating solidarity and cooperative economic activity. Digital social innovations helped advance offline activities in citizen urbanism. Included in movement thinking was a rejection of neo-liberal models of globally competitive, marketised cities and, in the context of urbanism, new ways of thinking and doing urban practices dedicated to prototyping open neighbourhood developments, and through this the production of common goods and services (Estalella et al, 2013).

Experimental platforms were being built, typically involving an ethic of openness and collaboration inspired by free software and free culture movements, for connecting local producers to consumers, promoting ethical and solidarity exchanges, and anticipating different kinds of digitally-enabled currency, peer-production and collaborative consumption. Digital citizen deliberation techniques were emerging from the multitude of groups, networks, platforms and associations throughout Spain (2011-13) (Gutiérrez, 2017; Monterde et al, 2015). Activists in Barcelona worked in collaboration with activists in Madrid, A Coruña, Sevilla, and other cities in Spain. At the same time as developing tools, there were debates and discussions about the conceptual frameworks for organising this activity, and for doing so strategically. Threading together the kaleidoscope of initiatives were commitments to direct democracy, transparency and citizen-centred forms of governance, and borne of indignation towards an incumbent system deemed (in the context of revelations of political and business corruption emerging after the economic crisis) to be inept, corrupt, closed, and self-serving (Gutiérrez, 2017).

The new visions for direct democratic urban practice were inspired by affinities between concepts coming from autonomist and feminist movements, free culture movements, and, significantly, the free software movement. A hacker ethic towards decentralised forms of online coordination, collaboration and peer production, and commitment to transparent and democratic rights in technology, informed the conceptual thinking. If the smart city

vision subsumed (and shaped) digital affordances within a logic of markets, service provision and neo-liberal ideas about urban efficiency, then here, activists were shaping digital affordances and applying them within a quite different framework. A generation accustomed to accessible digital technology speeding up their ability to communicate and organise, took this practice in a seemingly more directly democratic direction. Social media tools were adapted into 'technopolitical media' for: collecting ideas; discussing them, opposing them and modifying them; voting and taking decisions; and communicating this through content creation using new media (Kurban et al, 2017). These tools proved promising and helpful, and took the concept of digital cities in quite different directions compared to the closed development of dashboards and platforms by technology corporations, and in which data is centralised, released conditionally, and wraps a veneer of transparency and controlled participation around existing urban institutions. Moving beyond these elite forms of e-government, technopolitical activists were working at canvassing citizen knowledge to build more direct decision-making, and citizen-led urban governance, and connecting citizens as protagonists in new relations with representative democratic institutions (Kurban et al, 2017). These digital platforms relied upon voluntary contributions of knowledge and skill, and crowdsourced funds. The code for tools developed originally to organise 15-M occupations, and for coordinating and debating developments in initiatives and movements thereafter, was shared through GitHub, such as the Consul free software. Early platforms like Propongo, and tools used by Partido X and Podemos, went on to underpin city platforms like Decide.es, and that are now being used by a variety of city administrations.

All this was happening at the same time as the international promotion of Barcelona as a smart city. Activists saw two different cities: the elite Barcelona using smart city as a brand in its neo-liberal competition for capital – a city rendered into an efficient and convivial location for mass tourism and the global knowledge economy; and the Barcelona of neighbourhood activism, struggling to build from below what they considered to be a more democratic urbanism capable of addressing issues and problems considered inherent to the neo-liberal model. Tellingly, when the city council moved to open one of its first Ateneus de Fabricació Digital in the disadvantaged neighbourhood of Ciutat Meridiana in 2013, for example, the building they chose was already being used by a community food bank. Neighbours occupied the building in protest: they needed food and local solidarity, not 3D printers and design platforms. A resolution was found in re-housing the food bank and committing the Ateneu to training young people into work. The event illustrated a clash between the citizens envisaged by the Council in the future smart city with the pressing realities confronting citizens today (Smith, 2015).

The example of decision-making platforms illustrates how various technopolitical actors were helping connect traditional forms of urban activism to new scales and forms of agenda-setting, decision-making and mobilisation amongst citizens, and in so doing create

new ways of knowing and acting in the city. Mistakes, lessons, and knowledge production could proceed rapidly: about local activities, discussed, shared, reframed, aggregated with knowledge about similar initiatives elsewhere, and mobilised and organised for a more participatory, commons-based and democratic kind of urbanism. Platforms provided new ways of engaging and connecting with more traditional forms of neighbour mobilisation. Activist were practising an incipient urban governance operating beneath and around existing institutions. Ultimately, however, some activists argued that if democratic technopolitics – the subversive use of technologies combined with legal and political tools – was to realise its potential in less precarious and more influential ways, an engagement with city institutions was necessary (Kurban et al., 2017). New parties like Podemos and Barcelona en Comú were formed from amongst activist networks as a strategy to enter and transform urban institutions (Eizaguirre and Pradel-Miquel, 2017).

3.3 Technological sovereignty

Democratic technopolitics was instrumental to the development of the new political parties that emerged from the 15-M social movements, including Podemos and Barcelona en Comú. Platforms were used to select candidates, publish financial information, set agendas, debate issues, communicate across meetings, decentralise campaigns to local groups, communicate with allied groups, networks and movements, and keep leaderships accountable to the horizontal networks that constituted their power base. Working in this way in 2015 city elections (Eizaguirre and Pradel-Miquel, 2017), Barcelona en Comú won enough votes to form a minority city government in partnership with other parties. Ada Colau, who had been a spokesperson for PAH, became Mayor.

Smart urbanism was not a priority compared to issues of housing, corruption, mass tourism, rights to the city, and aspirations for more commons-based economic activity and the remunicipalisation of core city services. Nevertheless, digital tools for public deliberation were emblematic of aspirations to create a new way for city politics. Moreover, the underlying vision for approaching these and other issues, seeking commons-based developments through citizen participation, were informed by ideas in free culture and commons-based urbanism similar to those inspiring democratic technopolitics. The smart city of the previous administration came to be reconsidered through a technopolitical lens, and digital urbanism in the city reoriented to a policy of technological sovereignty. Another strand to the technological sovereignty vision was mounting concern about the concentration of data in the hands of a handful of poorly regulated technology platform providers. Wikileaks revelations of state interest in this data similarly heightened concern about data and control over technology. Questions of data sovereignty and the capacity of citizen rights in basic information utilities were a topic moving beyond digital activism and into the public eye.

It took time to develop a digital strategy aligned to the democratic urban commons towards which the new city government aspired. Studies were commissioned and people appointed, including Francesca Bria as Chief Technology and Digital Innovation Officer, and who had a background in European digital projects aligned to technopolitical aspirations. Some of these projects, such as the D-CENT citizen deliberation platform, involved technopolitics activists based in Barcelona. The new Digital City Plan for 2017-2020 was published in October 2016. The leitmotif for the new plan was to move beyond the smart city and transition to technological sovereignty. Transparent digital technologies accountable to citizens were sought in the strategy, and that would contribute to urbanism that is commons-based, circular and creative (Barcelona City Council, 2016). Council policy is to develop a data commons, and to use this transparently through open source digital practices. It involves a redirection and redevelopment of the Operating System projects inherited from the previous administration.

Emblematic projects have been established to implement the plan. Decidim.Barcelona has taken the technopolitics platforms for activist agenda-setting and decision-making, and developed these into a platform for citizen participation in urban policy and development.[4] In keeping with the activist ethos, not only is the platform open source, but so too is the process for reflecting upon its operation and future development through a 'meta-lab' of open debate. This includes discussion about connecting online deliberation with face-to-face discussion and activity: bringing social weight to online information through the involvement of urban groups and the organisation of neighbourhood meetings. Decidim benefitted from earlier work in the D-CENT European Commission project for developing direct democracy platforms and which involved Francesca Bria, then at Nesta, and other European partners. A further European project, called DECODE, involves the city council digital team working with European partners in the development of blockchain techniques aimed at giving citizens greater control over their digital identity, with tools to help them set the way their data is shared for public good purposes (cf corporate models of data extraction). Meanwhile, Decidim has been used to open up council processes to citizen participation, in the form of canvassing ideas and suggestions, coordinating comment and discussion, and voting on decisions, and which have input to planning documents, local initiatives, budgeting, and other areas. It is currently being used in a process to rethink the development of the 22@ district and open it to citizen proposals. The aspiration is for new ways for people to participate in knowing and shaping the city: not as data points, but as co-designers.

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[4] The code and services offered by Barcelona.Decidim, and the Decide platforms from which it forked, are being taken up by other cities around the world and competing against commercial citizen participation services..

Inserting these new design requirements into contracting arrangements with digital service providers has been part of the technological sovereignty policy. The reform of public purchasing policy to require open software and see data ethics encoded into techniques that give each citizen rights over their data is a key measure, although it is as of yet unclear what kinds of changes these requirements will induce. It is not always possible to renegotiate arrangements to the proprietary contracts struck by the previous administration, and so not all digital governance is retrospectively sovereign to council and citizens. Increasing diversity amongst vendors and providers, and not being reliant upon a limited number of packages, is another way the city authorities are trying to assert sovereignty. The promotion and opening up to digital social innovation providers, for example, and taking policy cues from free culture approaches, involves city authorities inserting values and assumptions that differ from those of the previous regime into digital infrastructures and services. Digital methods are being applied to the issues central to Barcelona en Comú's political vision, such as Big Data techniques for advancing socially inclusive housing and addressing illicit holiday lets, for example; or ensuring participation in the design of neighbourhood projects; or the commitment to transparency in public administration and politics.

Such diversity and more hybrid arrangements work to shift political relations in digitally enabled knowledge about the city. But the technology sovereignty vision is nevertheless tempered by the necessity of remaining competitive in a global digital economy. The strategy is careful to go beyond the smart city, while not rejecting smart urbanism. The plan speaks to diversify the digital economy. Agreements and provisions are made to continue promoting Barcelona as an attractive investment location for technology firms. Barcelona Activa remains an important hub for entrepreneurship, but now includes a team dedicated to supporting the solidarity economy, and which helps groups pioneering digital social innovation in the city. The promotion of the city to capital continues with Smart City Expo and Mobile World Congress. There are policies for promoting skills and facilities for Industry 4.0, at the same time as support for a Makerdistrict and continued promotion of the Ateneus de Fabricació Digital. This raises interesting questions about the flexibility in which some knowledge producing activities can easily move into the technological sovereignty rationale with little apparent change in practices. Programmes and initiatives to enable active citizen involvement in digital commons can equally equip them to work in the digital economy.

In all these changes in the political rationalities in relation to smart urbanism projects, it is important to remember that political leadership in the technology sovereignty strategy comes from a new political party borne of social movements, yet whose minority position in the council leaves it dependent upon agreements with other parties with differing 'political rationalities' (see the Introduction chapter). Moreover, the elected city council inherits city institutions and administrative bureaucracy and materialities (the Operating System, for

example, and contracts already in place) shaped by historic layers of complex economic, social and political compromises not of their own making, and with which the digital strategy has to negotiate.

Not all urbanism is viewed through a digital lens, whether sovereign or smart. We write this chapter during the crisis in relations between Catalunya and the Spanish state, in which older forms of politics are dividing opinion and playing for advantage, and while Barcelona en Comù is a minority government that recently became even smaller after a recent fallout with one of its coalition partners. Highly charged contentions over sovereignty, democracy, and governance are at stake, and in which Barcelona's future rests.

4: COMPETING RATIONALITIES OF SMART CITY FUTURES

The picture that emerges from our theoretical review and the example of Barcelona suggests more nuance is needed compared to the smart city solutionism of advocates and the troubling hegemony seen by critics. Smart city technologies do not land in cities as packages for installation or domination, but are actively shaped by specific urban situations that have histories and geographies; in which smart city initiatives negotiate complex institutional layers, and where digital initiatives are shaped and altered as much as digital imperatives shape those contexts.

In Barcelona, we see two major, contesting political rationalities for digital urban development, each emerging from global discourses as well as Barcelona's socio-material history and the specific life histories of key urban actors. Under mayor Trias, a smart city marketplace emerging from the corporate world was being promoted as an attempt to revitalise the competitiveness of the urban economy combined with programmes in which citizens were invited to train and experiment in the use of digital technologies. This rationality draws on Barcelona's history as a showcase model for modern urbanism, which is tangible in Barcelona's present-day socio-material urban fabric for example through its ongoing role as host of events such as the Smart City Expo, the material presence of the Cerdà plan in Barcelona's street layout, and the legacy of earlier international urban events. It is also inspired by the personal experience of Antoni Vives and Vicente Gaullart, who had been co-founders in 2001 of the IAAC, which was dedicated to advancing research and education on the use of new technologies in urban spaces. On the margins, and later under mayor Colau, this position was challenged by another political rationality which rejected neo-liberal models of globally competitive, marketized cities. Within the context of Barcelona's housing crisis and drawing on the city's history of social movements, this alternative was committed to direct democracy, transparency and citizen-centred forms of governance (Gutiérrez, 2017; Eizaguirre and Pradel, 2017). For its engagement with digital technologies, this movement drew on a hacker ethic, working with decentralised forms of

online coordination and open source technologies, committed to transparent and democratic rights in technology.

As part of these different political rationalities, different kinds of smart knowledge configuring technologies were created. An important point to take from this is that knowledge politics figures around a multiplicity of urban transformations, not a single transition process. Under Trias, systems monitoring and controlling traffic, energy, water use in parks, waste collection services and more were put in place, and which were to be combined in a City Operating System under uncertain and complex arrangements of ownership and control between city authorities and companies supplying these technologies (Bakici et al., 2013; Kuyper, 2016). Such systems create knowledge based on the relatively passive participation of people and objects, whose behaviour is observed and measured using sensors and algorithms. These technologies were not introduced throughout the entire city, but in specific sectors, issues and/or districts amenable to prevailing investment and development opportunities. And, on the margins, there were resourceful spaces for activists and social entrepreneurs to develop alternative digital practices (including European Union programmes[5]), and which have also been infiltrating smart urbanism (Tironi and Sanchéz Criado, 2015; cf Marvin and Luque-Ayala, 2017). These examples illustrate that urban agencies always need to be taken into account when trying to understand smart urbanism, also when the influence of neo-liberal ideology and international corporations is strong.

Urban agencies are even more tangible in the case of smart knowledge configuring technologies that emerged among grassroots movements and later when Barcelona en Comù took minority control of the council. This episode shows that political rationalities and smart knowledge configuring technologies intersected and co-evolved, rather than one informing the other unidirectionally. Furthermore, the technologies that were created among grassroots movements at the time of the housing crisis are materially very different from the sensing and monitoring systems put in place under mayor Trias, and through their material difference facilitate different kinds of politics. Initially, grassroots movements appropriated open digital technologies for coordination and communication, based on principles of openness, accessibility, collaboration, decentralisation and sharing. These technologies helped to organize effective direct-action and to develop alternative political visions. Digital tools were also being developed to assist and coordinate solidarity and cooperative economic activity, for example connecting local producers to consumers. Changes in control of the city council in Barcelona then opened up space for grassroots approaches to move beyond prototyping, beginning to institutionalize. The city's new digital strategy seeks technologies accountable to citizens, technologies which contribute to urbanism that is commons-based, circular and creative (Barcelona City Council, 2016).

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[5] See, for example, projects funded by the Collective Awareness Platforms for Sustainability and Social Innovation funded by the EU H2020 and FP7 programmes. https://capssi.eu/

Decidim.Barcelona was developed, facilitating communication with established institutions on policy issues through a combination of online deliberation with face-to-face discussion (Kurban et al., 2016). Commitments to values of openness, transparency and participation materialize through the design of the platform: it is open-source, and there is space for reflection on the platform's operation and future development. The creation of knowledge through Decidim.Barcelona and other platforms relies on the voluntary contributions of participants, who gain rather than lose agency through their participation. The politics of knowledge here spills beyond a powerful agent introducing synoptic technologies that consolidate and extend the framings of dominant interests in urban development: digital technologies are opened up by dynamic and contradictory initiatives in the city, between different urban actors and developments, and smart technology becomes a strategy for redefining and redistributing power relations in urban development. Indeed, the Barcelona case shows that a plurality of political rationalities sought different expectations, values and assumptions in the design of digital services, which had to be negotiated in the creation and use of technologies in the city.

5: CONCLUDING REMARKS: AVENUES FOR FUTURE RESEARCH

It is important to be reflexive towards the analysis presented here. Our approach to understanding the knowledge politics of smart urbanism looked at how contending ideas and experiences in urbanism, linked to shifting political control in the city, shaped and were shaped by the development of digital apparatuses for knowing and acting in the city. Our own knowledge producing apparatus (our analytical framework and method) was productive for this purpose, but also overlooks important aspects of knowledge politics in smart urbanism. Our framing at the level of the city as a whole meant that the development consequences of fixing specific urban sub-systems through digital means was outside our focus. To what degree, for example, do investments in specific smart systems entrain a degree of path-dependent developments that are difficult to dismantle or re-orientate, should that be desired or required? Recoding and retooling is no straightforward matter once sociotechnical configurations stabilise and institutionalise. Indeed, technologies have a tendency to hardwire social relations (Latour, 1991), and to act as a source of inertia or even path-dependency over social relations seeking reforms (Kemp et al., 1998).

Furthermore, it is clear that further in-depth analysis of the enactment of smart technologies, such as sensor networks, or city databases or digital fabrication facilities, are required to assess the material consequences of core functional logics in digital approaches, to understand whether and how the computational logic of these smart technologies is susceptible to changes in urban rationale, and which knowledges are bracketed out or

included in re-aligned digital codifications.[6] For example, knowledge about sustainability appears in reduced form in the smart city and technology sovereignty strategies in Barcelona. Notions of a self-sufficient city in the previous administration included an ecological modernist notion of how digital technologies will manage better urban metabolisms and close the loops of production and consumption through digital fabrication. Commitments to a circular economy in the technology sovereignty strategy similarly see sustainability in terms of managing material flows and metabolisms. The material and social footprint of digital technologies themselves are glossed over. Any risks that digital infrastructures lock societies into accelerated cycles of upgrades and obsolescence, and whose material implications are troubling, are currently skirted around by digital policy. Knowledge that critiques ecological modernisation (York and Rosa, 2003), and that problematizes innovation as a solution to sustainable development, is not integral to the digital apparatus of knowledge production. Framings of urban sustainability that see socio-ecological relations as more than informational, and that propose less instrumental, more experiential and embodied ways of knowing and sensing, do not (yet) connect to digital framings and knowledge producing apparatus. There may be affinities as well as tensions: for example, can we conceive of digital technological sufficiency?[7]

Indeed, with respect to inherent characteristics of approaching the urban through digital methods, one may ask: whoever is framing the urban issue towards which computation is addressed, are those groups nevertheless implementing a conception of the urban "as just assemblies of functions and processes and of human agency as no more than the enactment of routines and procedures that can be embedded in software"? (Kallinikos, 2011: 47). Through the use of digital technologies, wide-scale data can be brought together in unprecedented ways to inform (or even automate) decisive actions in real-time. Inserting smart city platforms into cities may consequently privilege those forms of computational codified knowledge, and gives greater affordance to functional and instrumental processes above other forms of knowing and acting in the city such as knowledge embodied through acts of neighbourliness, or culturally-informed ways of caring. Making a smart city operational would imply turning the actual city into a system: "urban processes, agents and stakeholders, in order to be part of analytics, insights and action, have to be inside the presumptions of the software system itself… Whilst incorporating diversity and the ability to develop relationships, the need for modularity, interoperability and transferability across systems – and cities – revokes specificity" (Marvin and Luque-Ayala, 2017: 15-16).

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[6] Such studies are underway in the research project from which this more general case study chapter comes – see Knowledge Politics of Smart Urbanism https://smartknowledgepolitics.com/

[7] Initiatives like the Open Source Circular Economy Days are one forum for exploring these possibilities. https://oscedays.org/

On the other hand, data can be re-contextualised, and given greater social weight when framed and interpreted by the knowledges associated with plural experiences in the city (Tironi and Criado 2015). Open and transparent computation might help reveal implicit political and economic interests residing in hitherto unquestioned or unreflective notions of system operational efficiency, functional integration and purposes like international competitiveness. Hidden assumptions in the codifications of the software, and the loss of situated knowledge in the abstractions of the platforms, can be identified, rendered explicitly, and lead to corrections when code is open and programs run transparently. According to Kurban et al. (2016, 14) and the idea of technopolitics, "this dynamic and contentious process amongst various actors reconfigures political relations and power dynamics through conflicting appropriations as well as negotiations [of the technology]." This would imply that the areas of urban life where computation is applied, and the agendas they serve, can be democratically controlled. Indeed, a critical challenge for further research focussing on the workings of smart city systems in practice is to understand whether there are inherent characteristics of computational ways of knowing the city, how those play out in relation to non-computational ways of knowing and governing the city and whether digital projects can indeed be (re)conceived through urban politics that interact across elite and grassroots settings, creating more plural and hopeful possibilities as is being attempted in Barcelona.

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