Emerging platform urbanism in China: reconfigurations of data, citizenship and materialities

Federico Caprotti[1*] *and Dong Liu*[1]

[1] *University of Exeter, Department of Geography, College of Life and Environmental Sciences, Exeter, EX4 4SB, United Kingdom.*

** Corresponding author. Contact details: f.caprotti@exeter.ac.uk*

To cite: Caprotti, F. and Liu, D. (2019) Emerging platform urbanism in China: reconfigurations of data, citizenship and materialities. Forthcoming in *Technological Forecasting and Social Change*

Emerging platform urbanism in China: reconfigurations of data, citizenship and materialities

Federico Caprotti[1] and Dong Liu[1]*

[1] University of Exeter, Department of Geography, College of Life and Environmental Sciences, Exeter, EX4 4SB, United Kingdom.

** Corresponding author. Contact details: f.caprotti@exeter.ac.uk*

Highlights

* Platform urbanism increasingly defines the ways in which cities develop for the future
* Platform urbanism is one of the latest developments of the smart city
* Chinese platform urbanism challenges currently held notions of urban citizenship and urban lifestyles
* China's urban platforms show domestic as well as international patterns of mobility

Abstract
In this article, we argue for an extension of current debates on smart urbanism in China by focusing on the emergence of urban platforms as a key way in which Chinese cities are developing into digitally-enhanced and governed urban areas. China has undergone multiple rounds of thematic urban development, culminating in a recent policy focus on the smart city and on digitally-enhanced urbanism. We argue that this has now evolved, and outline the rapidly emerging phenomenon of platform urbanism, which we conceptualise as not only confined to the policy sphere, but as stretching across the policy-governance-corporate nexus, the market, and urban consumption practices and broader culture. We do so by focusing on key themes emerging in contemporary platform-based digital urban development in China: a.) the rapidly developing geography of urban platforms; b.) a swiftly expanding mass of data and its implications for state-private sector power geometries; c.) domestic urban policy and practice mobilities, and consequences for the circulation of digital urban platforms between cities and across national boundaries; d.) implications for a reconfiguration of urban citizenship; e.) new configurations of urban materialities in the digital platform era. We conclude with brief reflections on data-led urbanism in contemporary China.

Introduction
China's urban development has undergone several phases since the 1980s. A number of key themes have emerged at different times during this period of hyper-urbanisation (He and Qian 2017). From the focus on development zones from the 1990s onwards (Yeh and Wu 1996), to the realisation of world city visions (Wu 2000) and spectacular architecture (Ren 2011), to the promotion of low-carbon and eco-city blueprints and projects in the mid- to late-2000s onwards (Wu 2012), China's cities have been the stage of various rounds of (often contemporaneous) future-focused development trends. From the early 2010s onwards, smart cities have rapidly emerged as a key lens through which to think about China's urban future (Cowley et al 2018). Smart urbanism is difficult to define, but can be broadly described

as a focus on data-centred urban development and on digital technologies and infrastructures that enable more efficient and integrated urban management, governance and economic activity (Kitchin 2014).

In this article, we argue for an extension of current debates on smart urbanism in China by focusing on the emergence of platform urbanism. Urban platforms are a key way in which Chinese cities are developing into digitally-enhanced and governed urban areas. We define urban platforms as digital software and hardware-based interfaces that: enable multiple users to interact and multiple (financial and other) transactions to be carried out in real time or near-real time; are centrally focused on leveraging the ability to analyse, manipulate and (sometimes) monetise large flows of digital data; have an effect, or multiple effects, on the way urban life, broadly understood, is conducted. While the smart city, as defined above, is generally focused on a range of data-centred technologies, platform urbanism can be described as an extension of smart urbanism that focuses on digital platforms, in various iterations and typologies, as the key interfaces between growing amounts of urban economic, social, cultural and political data and approaches to processing, managing, operationalising, commodifying and controlling this data.

In the following, we highlight key themes emerging in contemporary platform-based digital urban development in China: a.) the rapidly developing geography of urban platforms; b.) a rapidly expanding 'data bomb' and its implications for state-private sector power geometries; c.) domestic urban policy and practice mobilities; d.) implications for a reconfiguration of urban citizenship; e.) new configurations of urban materialities in the digital platform era. We conclude with brief reflections on data-led urbanism in contemporary China.

An emerging geography of platforms in urban China

China's rapid urban development in the past few decades has been increasingly paralleled by the swift rise of digital industries. Corporations such as Google, Amazon and Ebay have emerged as private sector near-hegemons on the global stage. At the same time, the Chinese domestic market has seen a parallel, more rapid development in the rise of very large, domestic technology firms, such as Baidu, Alibaba, Tencent, Huawei and others. Just as China has grown to be known as the leading BRIC (Brazil, Russia, India and China) economy, so its leading digital technology corporations have come to be known as the BATs (Baidu, Alibaba and Tencent) (He 2017). More broadly, China's digital economy has grown in size, scope, and impact. The number of unicorn corporations (defined as privately-held start-ups valued at over US$1bn) in the country in 2017 was 34, compared with 47 in the US and 19 in the rest of the world. Concurrently, the value of e-commerce transactions in China is now worth more than the sum of e-commerce transactions in the US, Germany, France, Japan and the United Kingdom combined (Woetzel et al 2017).

The rapid development of a domestic digital industry with international reach has connected with urban development through the generation of large volumes of data, as well as communication, governance and sensing capabilities: from sensor networks, to smart city management dashboards, to facial recognition systems. National priorities around smart city development (championed by the central government throughout the 2010s and especially from the 12th (2011-15) Five Year Plan onwards) have been bolstered by this technological and economic development. As early as 2014, 'all the cities at provincial or above level, 89%

prefecture-level cities, and about 40% county-level cities' had smart city strategies in place (He et al 2018: 668). At the same time, a key development has been the rise in platform-based access to data-enabled urban economic and governance services. A key way of illustrating this is through the rapid emergence and adoption of smartphones: in 2008 there were 17 million smartphones in use in the country, rising to 1.09 billion by 2018 (Yang and Xu 2018). Although smartphones are simply one window into the platform economy, their multiplication is testament to the increasing importance of digital platforms for understanding the ways in which the economy, governance, and cultures of consumption and urban experience are evolving.

The confluence of a highly developed digital economy, smart city-focused policies, the generation of digital data, and the adoption of platforms as ways to access, use, and consume data and services (Lee and Hwang 2018) has meant that platforms are now a key way of experiencing, regulating, governing and measuring the Chinese city. Many readily identifiable Chinese digital urban platforms are consumer-focused, from the Didi Chuxing ride-hailing service, to Alipay's mobile payment system. Nonetheless, there also exists a range of complex urban governance-focused platforms. Projects such as Hangzhou CityBrain, developed by Alibaba and based on a cloud computing architecture, are a case in point. CityBrain is an urban governance-focused platform that utilizes real-time sensed data to both optimize car journey times across Hangzhou city and provide automatic monitoring of traffic and other violations and infringements. The system processes data streamed from multiple sensor systems including more than 2,000 cameras (mounted on traffic lights and other elements of urban infrastructure), as well as vehicle trajectory information (Min et al 2018).

What is particularly interesting about projects such as Hangzhou CityBrain is the interplay between local governments (who request, co-design and pay for digital solutions), and technology corporations (who co-design and deploy platform systems) in terms of balances of power and agency. This interplay between policy, corporate and other actors in an entrepreneurial system of innovation and technology development is an example of the development of what has been termed a social technology (Andreani et al 2019). It also points to the need to investigate multiple stakeholders and drivers in any investigation of platform urbanism (Brem and Radziwon 2017). These more general aspects, however, as well as CityBrain's specific characteristics, are still centred on platform urbanism's key component: data. Corporations enable the generation, analysis and manipulation of data through data analytics and Artificial Intelligence (AI), but different levels of government are active in attempting to retain power over data through regulatory means. This highlights the highly glocal nature of platform urbanism, rooted as it is in the interplay between global drivers and local contexts (Dameri et al 2019). Thus, China's emergent platform urbanism exhibits characteristics that are not simply market-based, but that hinge on evolving relationships between different scales of government and the rising power of domestic digital technology corporations.

The rise of Chinese digital platforms is to be noted for its rapidity as well as its societal and urban pervasiveness. In addition, urban platforms have clearly started to impact on the shape of smart cities in distinctly spatial ways, as will be seen below. There exists an emergent literature discussing platform urbanism and its undergirding of cities (van der Graf and Ballon 2018): much of this has been focused on specific types of platforms such as urban data

platforms (Barns 2018). Understanding the typology of urban platforms emerging in Chinese cities is key to analyzing the effects that these platforms are having on the urban sphere. Although offering a comprehensive typology of contemporary Chinese urban platforms falls outside the scope of this article (and would in any case simply provide a snapshot in time of a fast-developing field of urban experience and materiality), it is nonetheless useful to sketch and illustrate some general contours. These can then be rendered more detailed through further in-depth, longitudinal empirical and theoretical research. Briefly, and based on an adaptation of Srnicek's (2016) typology of platform capitalism, Chinese urban platforms can be categorized as falling within one or more of the following types:

Advertising platforms, such as Tencent's Wechat, or Soso, Baidu and Toutiao, focused on extracting data for the purposes of generating revenues from advertising. These were often the first-mover platform-focused corporations, not just in China but worldwide (where the likes of Google and Facebook were largely focused on advertising).

Commercial/Retail platforms such as JD or Taobao, centered on providing an interface through which a range of commercial goods and commodities can be ordered and sourced.

Sharing platforms, which are central to the sharing economy and based on the use of the platform to enable access to products, goods and services (such as car rides through Didi Chuxing, or Meituan for a range of services including food delivery) that are not directly owned by the platform operator.

Governance platforms, such as Alibaba's CityBrain system, aimed at enabling data-focused urban governance and steering in a range of urban sectors from transport, to emergency response management, and the like.

Payment platforms, such as Alibaba's Alipay, or Tencent's WeChat Pay. These have become ubiquitous: both Alipay and WeChat Pay individually handled, in any single month in 2017, more payments than the annual total of UUS$451bn handled via US rival PayPal (Fraser 2018).

The involvement of corporates, and of municipal governments, has contributed to the generation of specific geographies around platform urbanism in China. Chinese platforms are largely owned or invested in by domestic technology corporations. This includes the BATs, which have a combined market capitalization of nearly US $600bn, and an average rate of year-on-year profit growth of over 50% (Greeven and Wei 2017). In terms of geography, a case in point is that the three Chinese internet giants are headquartered in three leading cities: Beijing (Baidu), Hangzhou (Alibaba) and Shenzhen (Tencent). This geographical distribution matters, since each corporation has engaged with local government in the vicinity of its headquarters city. Alibaba's CityBrain project in Hangzhou, for example, has also been rolled out to surrounding cities including Suzhou, Quzhou, and Shanghai. Tencent, meanwhile, has participated in digital city planning projects in Shenzhen and Guangzhou, and Baidu has carried out work along similar lines in metropolitan Beijing. While each corporation's geographical focus, and the involvement of local government, has been mirrored across all three headquarters locations, at the same time a key area of differentiation has emerged in that each corporation has chosen to focus on different sectors of smart city and platform urbanism development. Tencent has largely focused on the digitalization and platformisation

of existing industries (particularly healthcare, security, transportation and digital governance). Alibaba has invested more closely in the application of AI technologies to the city. Baidu has centred a large amount of effort on geomapping and automation, such as through the use of its Baidumap system as a navigation platform for autonomous vehicles.

Platform urbanism and the 'data bomb'

The advent of platform urbanism has meant that state-corporate relations are being recalibrated to some extent. This is because smart city projects and policies, and urban governance and digital economic activity mediated by platforms, sees *data* placed at the centre of state-corporate, and state-market relations. As digital products have improved and developed, the data analytics and calculative power of corporate actors such as the BATs (and many others) have increased, as the 'digitalization, informationalization and gridding of all things' (Wu et al 2018: 61) proceeds apace. On the one hand, this potentially makes them qualified *and* trustworthy (over foreign firms) partners for state-led projects. On the other hand, data has become a key asset that requires negotiation and control.

The Chinese urban data landscape is increasingly complex. On the one hand, government-held data is significant in volume, but presents its own challenges. Liu et al (2015) point out that urban data relevant to cities in China is first of all dispersed between different government agencies, and is partly available online and offline. Secondly, different agencies' data may present overlaps which cannot be easily reconciled. Thirdly, government-held data is often heterogeneous, and exists in different formats related to a variety of geographies, or using varying longitudinal parameters. The volume of data can also be significant: in a single study covering just eight days of mobile phone-sourced data-gathering in Shanghai, a total of around 20 million different mobile phone identifications were recorded across 9,578 base stations used in the study (Shi and Yang 2017). This is a small window, using a single type of data, into the complex, high-volume and real-time nature of urban data gathering and potential analysis in contemporary urban China. Indeed, Liu et al (2015) highlight that the pace and scale of urbanization in the country is in itself a data challenge, as it requires synergies to be found between public and private actors, and for the ability to gather and analyse data in near real-time.

Thus, the gradual digitalization of urban life in Chinese cities has led to what we call a 'data bomb' era, whereby increasing volumes of data necessitate handling and processing capabilities that are typically held by corporate actors. While the exponential growth in data and computing power has led to the development of technological innovations such as AI (See 2017), it presents challenges at the same time. How to conceptualise this 'data bomb'? It is helpful to illustrate the volume of data by noting, based on Li et al (2015), that every day, Baidu processes c.6bn search queries, and its data expands by 10 TB per day. A single high-definition camera can produce up to 3.6 GB per hour: there are over 20 million such cameras in use in China today. Another example of large data volumes is Beijing's traffic control centre, which sees its data increase by 30 GB per day, and China's national grid generates c.510 TB of data per annum. Associated economies of data storage and processing are significant: the estimated cost for constructing a data storage facility for Tianjin's municipal security system is USD c.$7.25bn (Ibid). The corporate sector is increasingly the site where data processing and analytics capabilities are to be found, and where continuous processing can be enabled (McColl 2017). This potentially recasts the state (at certain points of the smart urban project

development lifecycle at least) in a client role. The fact that this could lead to a deepening imbalance in power geometries over data is also underscored by the successful (state-led) development of the digital economy, which has meant that top digital talent is increasingly attracted by domestic technology corporations (Zhang 2016) rather than the state.

Domestic urban policy and practice mobilities

Chinese cities currently engage with data through a combination of municipal- or state-led activities to generate, analyse and use digital data, and engagement with private sector corporations (both large technology corporations and smaller firms). At the same time, new policies and mechanisms to facilitate governance through data are emerging. An example of this is the CityBrain system, highlighted above. The shared need, across multiple cities, to handle large volumes of data in a new urban data governance era has led to the circulation of governance policies, frameworks and platforms throughout urban China. The CityBrain system, for example, has been deployed outside Hangzhou and is now being utilized in a range of cities including Suzhou, Guangzhou, Shanghai, Chongqing and Macau. This is part and parcel of the making and circulation of state-corporate urban policy mobilities (McCann 2011) in a domestic context. We argue that, due to the central involvement of corporate actors in designing the technical blueprints of systems like CityBrain, the circulation of these digital urban governance systems throughout China is testament not only to domestic, digital urban policy mobilities, but to the existence of *practice* mobilities as well.

Furthermore, it is clear that platform-enabled digital urban policy and practice mobilities are not simply confined to China. CityBrain, for example, was sold to Kuala Lumpur in 2018 as a way of enabling the Malaysian city to make its transport system more efficient. This signals the emergence of international urban policy and practice mobilities based on the rise of platform urbanism in China. This development raises key questions, for example around the extent to which non-domestic technology corporations gain access and exploitation opportunities with regards to urban data initially sourced for governance purposes. At the same time, the emerging international proliferation of international digital urban policy and practice mobilities also enables an alternative, less dualistic perspective on policy mobilities. This is denoted by the fact that while much of the urban policy mobilities literature has focused on North-South policy mobilities (Clarke 2012), examples such as CityBrain show different geographical trajectories, originating in the East.

Reconfigurations of urban citizenship?

A further question around emerging platform urbanism in China is its effect on urban citizenship. Firstly, does the increasing centrality of platform-enabled urban lifestyles, governance and consumption signify new directions in the ways in which citizenship is defined and experienced in the Chinese city, or does it simply herald a deepening of current citizenship trends? In part, digitally-enabled urbanism might seem to be simply *enabling* urban life for urban dwellers, while leaving current iterations and inequalities largely untouched (Joss et al 2017). For example, while many migrants to the city may interact with the urban economy through platforms, at the same time their exclusion from urban *citizenship* (and all that entails, including access to services) (Zhang and Wang 2010) may remain unaffected by their ability to use and access platforms. At the same time as existing fissures in urban citizenship status may be untouched (for now), digital platforms have the potential of redefining citizenship for existing citizens. For example, the proliferation of

governance platforms such as social credit systems (SCS) and their associated reward and disincentive mechanisms, signify an increasingly direct individualization of what is socially acceptable or not, in a range of areas of urban life, from consumption behaviours, to lifestyle patterns, to political expression.

To illustrate the potential reshaping of Chinese urban citizenship through urban platforms, it is worthwhile to consider China's national SCS. A state-led social credit programme was initiated in 2014 with the initial aim of enabling government to tackle corruption and other challenges. Although other countries use credit scoring systems (notably with regards to financial credit scores), China's SCS landscape has evolved and now represents, globally, the most comprehensive attempt to capture digital sources of data about citizens and to reconcile them within a single social credit 'score'. Trials are being conducted in 12 secondary-tier cities (Weihai, Rongcheng, Weifang, Suqian, Suzhou, Hangzhou, Yiwu, Wenzhou, Xiamen, Nanjing and Suzhou and Chengdu), and are similar, in terms of the government's lead role, to experiments with urban projects (such as smart cities and low-carbon cities) carried out since 2000. At the same time, corporate-led SCS are also active countrywide, such as Sesame Credit, developed by Alibaba and its subsidiary Ant Financial Services Group.

The Chinese SCS programme focuses on key elements as part of its development strategy: a.) data integration, namely the aim of reconciling data from a multiplicity of sources (from social media activity and networks, to consumer behaviour, to legal convictions, to financial creditworthiness) into a scoring system; b.) incentive creation, for example through lower mortgage rates for high-scoring individuals, or through blacklisting individuals. For example. Sesame Credit scores credit history, behavioural trends, ability to honour financial agreements (for example, bills), personal information and social relationships. Incentives available to Sesame Credit high-scoring individuals include expedited Singaporean and Schengen visa application procedures, reduction or waivers of deposits for a range of services, and access to fast lanes at airports. By 2017, over 380 cities had recognised Sesame Credit's scoring system (Creemers 2018) and had put in place incentives to lower deposits (for high scorers) in sectors including healthcare, social housing and other public services. Thus, social credit systems extend the notion of 'citizen as sensor' in the digital city, and towards a view of urban citizenship as ordered, rational, and as a response to direct stimuli from specific levels of government as well as from corporate actors. It is clear that the areas of focus of social credit systems being trialled across China have the potential of redefining citizenship so as to shape the citizen into an actor who performs what is expected of them by government through a specific form of 'smartmentality' (Vanolo 2014). The urban platform is the interface through which this form of governmentality is operationalised. In a broader sense, it is useful to place the citizenship effects of platform urbanism in a wider context that takes into account both risks and benefits to the development of digital urban platforms. The risks, for example, include ideological manipulation as well as the increasing corporatization of city government and 'a tendency to normalize a surveillance state' (Appio et al 2019: 11).

New materialities of platform urbanism

Our final brief observation focuses on the materialities associated with the rise of platform urbanism in China. As seen above, there are emerging geographies of platform urbanism in the country, including platforms associated with smart city projects across China's megalopolises and second-tier cities alike. The SCS example above also points to the broad

adoption and spread of specific urban platforms in multiple urban centres. Furthermore, as seen above, the corporate geographies of technology corporates also exhibit spatial patterns with regards to location, territorial zones of business influence, and partnerships with city administrations.

Thus, while platform urbanism can be seen as spatially fluid on the one hand (since the technologies underlying it can be applied across space, including non-urban spaces), the process of emergence of platform urbanism is deeply intertwined with the specific geographical contexts of local urban and economic development. This leads to a material, geographical patterning in contemporary Chinese platform urbanism. In turn, this reflects current uneven smart and other urban development patterns. As Li (2018, 14) et al note:

'China's high-level smart cities are mainly distributed in the Beijing, Yangtze River city belt and Southern China urban agglomeration, while the central and western economic zones are generally backward in smart city construction, posing an obvious gap with the eastern cities.'

Specifically, China's eastern cities display more integration of smart urban platforms in various areas of urban life, such as consumption and governance. In particular, cities near the eastern seaboard (and especially in Zhejiang and Jiangsu provinces), and on the southern seaboard (especially around Guangzhou) display the highest levels of activity and development. This broadly corresponds with the areas of corporate activity centred on two major technology corporations, Alibaba (headquartered in Hangzhou) and Tencent (based in Shenzhen, near Guangzhou). This may reflect the fact that initial urban smart and platform partnerships were developed between technology corporations and city governments local to their main bases of operations. It may also be a reflection of the fact that second-tier cities like Hangzhou were among the very first to experiment with the roll-out of urban platforms. It is important to note, however, that these geographical features are changing and dynamic, and that there is no predetermined pattern of activity with regards to platform urbanism. For example, Alibaba owns Gaode Map, which is central to geolocation technologies used by platforms; Gaode Map, in turn, is based in Beijing, while Alibaba's headquarters are in Hangzhou.

The emergence of a dynamic, patterned and uneven geography of urban platforms in China also involves the construction of specific materialities around these data-centred developments. Specifically, these materialities can be thought of as materialities around the digital infrastructures that enable platform urbanism. These include networks of sensors, cables, communications hardware and software, and data processing and storage. For example, Hangzhou Citybrain is based on an infrastructure of cameras, sensors, and digital networks that represent an assemblage of data, materials, knowledge, regulations, real-time behaviour and associated practices.

Platform infrastructure development is at times part and parcel of local development priorities. For example, Guizhou province has attempted to attract Big Data, smart and other high-tech industries (Liu et al 2014), and infrastructure around data storage is key to its blueprint for development as a centre for smart city-related industrial activity. A case in point is the construction of data centres in the province. These include Tencent's Seven Stars Data Centre in Gui'an: the facility is located in a network of underground caves and excavations

totalling 30,000m^2. It is split into two floors, features five 15-metre high entrances, and will house tens of thousands of Tencent servers. Guizhou's climate is a key factor, since a major energy draw for data centres relates to cooling: the facility will be able to use cold air for a large part of its cooling requirements. Another data centre, being built by Huawei in karst hills in Guizhou, will reportedly store up to 600,000 servers (Moss 2018). This points to a physical, infrastructural materiality and contingency around platform urbanism.

Platform urbanism also involves the generation of myriad localised materialities around production, consumption and lifestyle practices (Kwak et al 2019). These materialities exist on a spectrum from the purely technical (materialities around smartphone apps and materials) to the techno-social (such as participation in the platform economy of rural-urban migrants through platforms such as Meituan and Didi). In turn, it is key to note that some of the materialities produced through platform urbanism are not necessarily purely digital: for example, ride-hailing or meal delivery services involve networks of vehicles, fuel, logistics, food, advertising, and regulatory practices and negotiation. Thus, data-centred urban development has material consequences far exceeding the digital world and its networked infrastructures.

Finally, a key materiality that we have not considered here is that centred on the financial networks, and on mechanisms of financialisation, that enable the development of Chinese urban platforms. While a review of these financial networks lies beyond the scope of this paper, urban technological development capital is key to the production of China's urban future (Theurillat 2017). Mechanisms of land-based finance are central to local urban development in China (Lin and Yi 2011, Wu et al 2006), and to this we would add the need to explore and research networks of technology-focused capital and finance that involve both public and corporate sources of investment and funding. Additionally, specific platforms are starting to shape the financing of urban development, as seen through the development of urban investment platforms enabled by blockchain. Examples of this are the development of a blockchain-based platform to store real estate data in the city of Loudi, in Hunan province; or the Bank of Communications' September 2018 decision to issue US $1.3bn of mortgages through the use of blockchain (Berman 2018).

Conclusion

The emergence of urban platforms in China represents a rapidly developing extension of smart and digitally-enhanced urbanism in the country. Platforms have wide-ranging material impacts, and exist both nationally and in specific geographies and territorial configurations related to complex geometries of state and corporate power relations. We have highlighted how some of the potential effects of platform urbanism are highly significant in a social sense, including the potential for a recasting of urban citizenship. Thus, while urban platforms may represent a new era with regards to data-mediated urban life, they also represent a universe of new (societal, technological, ethical) risks and potential blind spots. Data is central to this transition, making it possible to talk not just of Chinese urban futures, but of urban data futures. Platforms are central to this evolution: as seen above, they mediate flows of data, capital, knowledge, political and regulatory practices and materialities in the production of new ways of governing, living in, and consuming the Chinese city. A key task for scholars of urban China, and of digital urbanism, is to engage with these fast-moving developments so as to provide critical and practice input and reflection at this key juncture.

References:

Almeida, V., Doneda, D., Moreira da Costa, E., 2018. Humane smart cities: the need for governance. IEEE Internet Comput. 22 (2), 91–95.

Andreani S, Kalchschmidt M, Pinto R and Sayegh A (2019) Reframing technologically enhanced urban scenarios: A design research model towards human centered smart cities. *Technological Forecasting and Social Change* 142: 15–25.

Appio F P, Lima M and Paroutis S (2019) Understanding Smart Cities: Innovation ecosystems, technological advancements, and societal challenges. *Technological Forecasting and Social Change* 142: 1–14.

Barns S (2018) Smart cities and urban data platforms: designing interfaces for smart governance *City, Culture and Society* 12 5-12

Berman A (2018) Chinese city in Hunan province launches blockchain platform for real estate data. *Cointelegraph*, 13 November 2018. Available at: https://cointelegraph.com/news/chinese-city-in-hunan-province-launches-blockchain-platform-for-real-estate-data

Clarke N (2012) Actually existing comparative urbanism: imitation and cosmopolitanism in North-South interurban partnerships. *Progress in Human Geography* 33(6): 796-815.

Cowley R, Caprotti F Ferretti M and Zhong C (2018) Ordinary Chinese smart cities: trhe case of Wuhan. In: Karvonen A, Cugurullo F and Caprotti F eds *Inside Smart Cities: Place, Politics and Urban Innovation* London, Routledge: 45-64.

Creemers B (2018) China's Social Credit System: an evolving practice of control. SSRN, 9 May 2018. Available at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3175792

Dameri R P, Benevolo C, Veglianti E and Li Y (2019) Understanding smart cities as a glocal strategy: A comparison between Italy and China. *Technological Forecasting and Social Change* 142: 26–41.

Fraser I (2018) Chinese payment giants are lightyears ahead. *Raconteur*, 25 September 2018. Available at: https://www.raconteur.net/finance/alipay-wechat-china-payments

Greeven, M. J., & Wei, W. (2017). Business Ecosystems in China: Alibaba and Competing Baidu, Tencent, Xiaomi and LeEco. Routledge.

He L, Huang Z, Wong S W, Liao S and Lou Y (2018) A holistic evaluation of smart city performance in the context of China. *Journal of Cleaner Production* 200: 667–679.

He, Y. (2017). How China is preparing for an AI-powered Future. Wilson Center. June. http://smartcity.cps.com.cn/article/201809/934090.html

He S and Qian J (2017) From an emerging market to a multifaceted urban society: Urban China studies *Urban Studies* 54(4): 827-846.

Joss S, Cook M and Dayot Y (2017) Smart cities: towards a new citizenship regime? A discourse analysis of the British Smart City Standard. *Journal of Urban Technology* 24(4): 29-49.

Kitchin R (2014) The real-time city? Big Data and smart urbanism. *GeoJournal* 79(1): 1-14.

Kwak J, Zhang Y and Yu J (2019) Legitimacy building and e-commerce platform development in China: the experience of Alibaba. *Technological Forecasting & Social Change* 139(February 2019): 115-124.

Lee C and Hwang J (2018) The influence of giant platform on content diversity. *Technological Forecasting & Social Change* 136(November 2018): 157-165.

Li D, Cao J and Yao Y (2015) Big Data in smart cities. *Science China Information Sciences* 58(10): 1-12.

Li G, Wang Y, Luo J and Li Y (2018) Evaluation on construction level of smart city: an empirical study from twenty Chinese cities. *Sustainability*, 10(9), 1-14. https://doi.org/10.3390/su10093348

Lin, G. C., & Yi, F. (2011). Urbanization of capital or capitalization on urban land? Land development and local public finance in urbanizing China. *Urban Geography*, *32*(1), 50-79.

Liu X, Song Y, Wu K, Wang J, Li D and Long Y (2015) Understanding urban China with open data. *Cities* 47(September 2015): 53-61.

Liu, Y., He, J., Guo, M., Yang, Q., & Zhang, X. (2014). An overview of Big Data industry in China. China Communications, 11(12), 1-10.

McCann E (2011) Urban policy mobilities and global circuits of knowledge: toward a research agenda. *Annals of the Association of American Geographers* 101(1): 107-130.

McColl B (2017) Superclouds: scalable high performance nonstop infrastructure for AI and smart societies. In Mehmood R, Bhaduri B, Katib I and Chlamtac I (eds) *Smart Societies, Infrastructure, Technologies and Applications: First International Conference, SCITA 2017, Jeddah, Saudi Arabia, November 27–29, 2017, Proceedings*. Springer, Berlin: 3-5.

Min W, Yu L, Yu L and He S (2018) People logistics in smart cities. *Communications of the* ACM 61(11): 54-59.

Moss S (2018) Tencent plans huge bomb shelter data center in Guizhou. Data Center Dynamics, 1 May 2018. Available at: https://www.datacenterdynamics.com/news/tencent-plans-huge-bomb-shelter-data-center-in-guizhou/

Ren X (2011) *Building Globalization: Transnational Architecture Production in Urban China*. Chicago, The University of Chicago Press.

See S (2017) Artificial Intelligence computing for a smart city. In Mehmood R, Bhaduri B, Katib I and Chlamtac I (eds) *Smart Societies, Infrastructure, Technologies and Applications: First International Conference, SCITA 2017, Jeddah, Saudi Arabia, November 27–29, 2017, Proceedings*. Springer, Berlin: 6-8.

Shi and Yang (2017) Application of Big Data in the study of urban spatial structures. In: Shen Z and Li M (eds) *Big Data Support of Urban Planning and Management*. Cham: Springer International Publishing AG, 255-272.

Srnicek N (2016) *Platform Capitalism* Cambridge, Polity.

Theurillat T (2017) The role of money in China's urban production: the local property industry in Qujing, a fourth-tier city. *Urban Studies* 38(6): 834-860.

Van der Graaf S and Ballon P (2018) Navigating platform urbanism *Technological Forecasting & Social Change* https://doi.org/10.1016/j.techfore.2018.07.027

Vanolo A (2014) Smartmentality: the city as disciplinary strategy. *Urban Studies* 51(5): 883-898.

Woetzel J, Song J, Wang K W, Manyika J, Chui M and Wong W (2017) *China's Digital Economy: A Leading Global Force*. McKinsey Global Institute Discussion Paper, August 2017. Available at:
https://www.mckinsey.com/~/media/mckinsey/featured%20insights/China/Chinas%20digital%20economy%20A%20leading%20global%20force/MGI-Chinas-digital-economy-A-leading-global-force.ashx

Wu F (2012) China's eco-cities *Geoforum* 43(2): 169-171

Wu F (2000) The global and local dimensions of place-making: remaking Shanghai as a world city *Urban Studies* 37(8): 1359-1377.

Wu, F., Xu, J., & Yeh, A. G. O. (2006). *Urban development in post-reform China: State, market, and space*. Routledge.

Wu Y, Zhang W, Shen J, Mo Z and Peng Y (2018) Smart city with Chinese characteristics against the background of big data: idea, action and risk. *Journal of Cleaner Production* 173(2018): 60-66.

Yang F and Xu J (2018) Privacy concerns in China's smart city campaign: the deficit of China's Cybersecurity Law. *Asia & the Pacific Policy Studies* 5(3): 533-543.

Yeh A G-O and Wu F (1996) The new land development process and urban development in Chinese cities *International Journal of Urban and Regional Research* 20(2): 330-353.

Zhang L and Wang G (2010) Urban citizenship of rural migrants in reform-era China. *Citizenship Studies* 14(2): 145-166.

Zhang L Y (2016) Winning the war for talent in China's 'new normal'. *China Business Review*, 19 October 2016. Available at: https://www.chinabusinessreview.com/winning-the-war-for-talent-in-chinas-new-normal/