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Datapolis: A Public Governance Perspective on "Smart Cities"

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Abstract

Smart cities are presented as both inevitable and benign futures: the technological development is unstoppable and will bring us wealthier, safer and more sustainable cities. Putting technology to use, however, is never entirely a matter of engineering but of strategic, political and value-laden choices. This article combines the literature on technology in the public sector and on (urban) governance to develop a public governance perspective on smart cities. The central theoretical concept "datapolis" highlights how the construction of smart cities can be understood in term of "actors," "rules," and "games" of urban governance. The theoretical analysis results in the identification of three types of actors (state, market, and civil society), three governance challenges (balancing perceptions, guaranteeing checks and balances and building upon different forms of knowing), and five governance games (the politics of data collection, data storage, data usage, data visualization and data access). The governance of smart cities is re-conceptualized as the socio-technical structures that emerge from the governance games. The governance challenge is to develop legitimate rules for perceptions, power relations and decisions in smart cities.

Introduction

In modern societies, technology is widely seen as the key to finding solutions to a broad range of wicked problems. Although in earlier decades technologies such as nuclear energy and genetic modification were critically assessed, faith in the power of technologies to improve our human condition is still strong. Especially in the context of so-called "smart cities," technology is presented as the means to make cities safer, cleaner, richer more accessible, and more innovative (for overviews: Caragliu, Del Bo, and Nijkamp 2011; Gil-Garcia, Pardo, and Nam 2015a; Meijer and Rodríquez-Bolívar 2016; Nam and Pardo 2011; Townsend 2014). This image is attractive to many practitioners: high tech companies present seductive images of futuristic cities to entice urban managers into investing more (public) money into technological solutions (Paroutis, Bennett, and Heracleous 2014).

Cities can be defined as smart when "investments in human and social capital and traditional (transport) and modern (ICT) communication infrastructure fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory governance"(Caragliu, Del Bo, and Nijkamp 2011: 70). Empirical studies provide a variety of examples of technological systems, such as transport systems; waste systems; energy systems and surveillance systems and the common denominator in all these different technological system is the key role of data (Su, Li, and Fu 2011; Townsend 2014). Collection and use of data is expected to result in more effective transport, better waste systems, more efficient use of energy and stronger surveillance. The notion of smartness leans heavy on big data collection and analysis. Optimist accounts stress that the datafication of society—all actions and operations generate data—offers a long range of opportunities for more effective management of the city (Batty 2013; Mayer-Schönberger and Cukier 2013). The idea that

use of these possibilities requires strong collaborations between different actors—often referred to as the triple or quadruple helix, that is, the networked relations among universities, industries, governments (and citizens) (Leydesdorff and Zawdie 2010)—is quite dominant in this literature and fits the perspective of public governance which highlights the importance of networked collaboration in the public sector.

Social scientists have critically analyzed the promises of urban smartness. Greenfield (2013) and Hollands (2008) highlight the technological discourse of the smart city is directly connected to the neo-liberal ideology. Their analyses form an important reaction to the techno-optimist discourse about smart cities, as brought forward by the industry (IBM, Siemens, Cisco), but also by scholars with a background in information management or engineering. The techno-optimist discourse tends to highlight the potential of new technologies, and view all forms of resistance as barriers that need to be tackled (e.g., Janssen, Charalabidis, and Zuiderwijk, 2012; Parente and Prescott 1994). At the same time, critical analyses do not present a neutral assessment of the value and limitations of new technologies for the city. Part of the problem is that the key concept—smart city—is both normative and fuzzy (Cocchia 2014). For this reason, a public governance framework is needed that enables us to study and understand the meaning of new technologies for urban governance without immediately qualifying these as desirable or dangerous. This article will conceptualize the smart city as the outcome of political and administrative interactions in cities: these interactions may produce desirable outcomes but can also be dominated by specific interests.

A public governance perspective presents a "lens" that academics and practitioners can use to study and govern the use of new technological systems in modern cities. In line with Kohler-Koch and Eising (1999), we define public governance as the ways in which the divergent preferences of citizens are translated into policy choices. Following Perry (2012), this article uses knowledge from various disciplines (public administration, political science, urban studies, information sciences) to produce a theoretical understanding of the governance of smart cities. We will use various (classical and more recent) theoretical perspectives on governance (Greasley and Stoker 2008; Kiser and Ostrom 1982; Kohler-Koch and Eising 1999; Salomon and Elliott 2002; Scharpf 1997) and combine these with the large body of (classical and recent) literature that has acknowledged using technology in a city is never a purely technical issue. These insights are translated into implications for the governance of smart cities in the 21st century (e.g., Bijker et al. 1987; Castells 1989; Fountain 2001; Greenfield 2013; Hollands 2008; Kraemer, Kenneth, and King 1986; Kraemer et al. 1989; Kraemer and Dedrick 1997; Nam and Pardo 2011; Taylor and Williams 1991). The article does not present new empirical research but uses the broad variety of cases and examples that have been published in the scientific literature (Bornschlegel 2011; Chainey and Ratcliffe 2013; De Lange and De Waal 2013; Fitzgerald 2016; Friso, Zantema and Mein 2013; Hamari, Sjöklint, and Ukkonen 2015; Kitchin 2014a, 2014b; Lavertu 2015; Mahizhnan 1999; Mears 2007; Ostrom 2010; Paroutis, Bennett, and Heracleous 2014; Paulsen 2004; Su, Li, and Fu 2011; Townsend 2014; Wallace 2009). In addition, we analyzed case studies on smart cities presented in a report by the UK Department of Business, Innovation and Skills (2013) with analyses of Chicago, Rio de Janeiro, Stockholm, Boston, Barcelona and Hong Kong.

The term "smart city" dominates debates about urban technologies but has limited academic values for its normative orientation and ambiguous meaning in the literature. For that reason, the key concept in the public governance perspective on smart cities in this article is the datapolis.[1] The datapolis can be defined as the complex set of relations between political community of citizens and urban data-infrastructures: the political community constructs data-infrastructures and, at the same time, these data-infrastructures condition relations and interactions in the political community of citizens. The concept of the datapolis underlines that data-infrastructures embody value judgments about the city and thus are not neutral tools but mechanisms for governing the political community of citizens (Garcia, Pardo, and Nam 2015b). Since the data condition interactions in the polis, decisions about the data-infrastructures are a form of meta-governance (Kiser and Ostrom 1982): constitutional-level decisions about institutional structures of governance. Data-infrastructures result from decisions in the polis and they also condition subsequent decisions at the policy and operational levels. These interrelation between political communities of citizens and urban data-infrastructures are at the heart of urban governance in an information age.

This article contributes to our theoretical understanding of urban governance by presenting a theoretical model of the relation between technology and urban governance. This role of technology is widely acknowledged in specialized journals such as Government Information Quarterly and the Journal of Urban Technology. The literature on (urban)

1 The development of the concept of the datapolis is inspired by Taylor and Williams' (1991) "information polity," who developed this concept in a time when people were talking about the "information society" and the "information economy" and they felt a new understanding of the polity was needed to match these developments.

governance, however, highlights a variety of issues such as policy networks and public–private partnerships in cities (Koppenjan and Enserink 2009; Kort and Klijn 2011; Le Gales 2001), the leadership of mayors and city managers in urban governance (Greasley and Stoker 2008; Zhang and Feiock 2009), urban policy-making (Kwon, Berry, and Feiock 2009; Smith 1978) and intermunicipal cooperation (Bel and Warner 2015) but ignores the role of technology in urban governance. Building upon Scharpf's (1997) perspective of "games real actors play," we will cover three aspects of governance of datafied cities: the "actors," the "rules," and the "games." The games that these real actors play according to (institutional) rules result in emerging technological and social structures. Scharpf's perspective helps to understand how these structures emerge from interactions between different stakeholders. This perspective is used to translate a technological understanding of the smart city into a public governance perspective that describes the smart city as a series of games between real actors with rules as the input and output of these games (see Table 1).

The contribution of this article to the literature on public governance is that the construction of urban technologies is conceptualized as a form of public governance: by studying specific technological games, we can understand how the institutional context of urban governance shapes technological developments but is also shaped by the new technologies. The governance of smart cities is re-conceptualized as the logics of smartness that emerge from the governance games. The challenge for urban governance is to develop legitimate rules for the perceptions of the city, for the power relations in access to information and for the knowledge basis for decisions.

Governance Actors: State, Market and Civil Society

Governance of modern cities means governing a city that is full with technological systems. Cities collect and process various data, such as census and demographic data; traffic data; policy evaluation data; school performance data; economic data; data from safety cameras; data about trees in the city and data about energy production and consumption (Townsend 2014). Cities also set up sensor networks, operation centers, LORA-networks, data centers, glass fiber infrastructures and data warehouses to collect, store and manage the data. Governing the smart city is not only about managing government data. Market actors, such as GPS and social media companies, continuously collect data about the whereabouts of their customers to optimize their services (Unni and Harmon 2007). Nonprofit actors, such as environmental groups and energy cooperations, also actively collect; gather; process and visualize urban data, in order to strengthen their fight for a greener city. Modern cities are *datafied cities*: all activities, situations, incidents, conversations, and interactions are being turned into data. Cities such as Chicago, Rio de Janeiro, Stockholm, Boston, Barcelona, and Hong Kong are all building information infrastructures, developing new forms of data collection and exchange and constructing new applications to tackle problem that vary from economic growth to sustainability and community engagement (Department for Business, Innovation and Skills 2013). These projects all aim to collect more data about the city in the expectation that this will lead to greener, more prosperous, safer cities.

The academic literature puts an emphasis on understanding the variety of data systems in cities (Townsend 2014). For an analysis of the smart city from a public governance perspective, however, a focus on the institutional logic of the actors who develop these data systems is more suitable. Who are the actors who construct the datapolis? To bring some structure into the broad variety of stakeholders in smart cities, three types of actors can be distinguished: state, market, and civil society (cf. Barber 1996). This basic distinction can help to understand the variety of arguments about

Table 1. Theoretical Analysis of the Governance of Smart Cities

Governance actors	- Who are the actors who construct the urban data infrastructures and what are their interests and preferences? - What is for these actors the proposed contribution of these infrastructures to the smartness of the city?
Governance rules	- Which rules guide the behavior of actors who construct the urban data infrastructures? - How do urban data infrastructures change the rules for interaction between actors?
Governance games	- Which are the games that actors play around the construction of urban data infrastructures? - What is the key challenge for public governance in terms of the legitimacy of the outcome of the game?
Emergent governance	- How do the games governance actors play according to different rules result in new technological structures? - How do these games change the social structure of urban governance in cities? - How do the technological and social structure of urban governance interact?

how technology can contribute to the quality or urban life since way in which they propose to make the city smarter—the promise of smartness—is quite different.

A first group of actors are the state actors (municipalities, regional governments, agencies). These actors primarily use data to enhance the efficiency and effectiveness of government and thus boost the output legitimacy of government (Gil-Garcia 2012). The Operations Center in Rio de Janeiro is a good example of this type of smartness (Kitchin 2014b). Data are brought together in a large center, where silos between government agencies are broken to enable crisis decision-making on the basis of more integral information. Smartness here refers to more effective handling of public problems and services.

A second group of actors are market actors (IT companies, telecom providers, platforms). Their key driver for using data is to enhance their profit but they can only do this if their usage of data provides value to the city. They can work for consumers, other businesses or for governments. One of the key contributions of these actors is that they make cities smarter by enhancing the use of resources in the city. Airbnb and Car2Go are typical examples of market smartness (Hamari, Sjöklint, and Ukkonen 2015). Available resources in the form of rooms and cars are used more efficiently, so that more people can stay in the city and fewer cars are needed. Data about the reliability of providers and customers creates the basis for these forms of sharing. Another important proposed contribution is better management of urban infrastructures by privatizing, for example, urban lighting or public transportation.

A third group of actors is individual citizens and their civil society organizations. The use of data contributes to urban smartness by developing new forms of collaboration between citizens to tackle different urban problems. The key argument here is that the transaction costs of collaborations in urban environments can be reduced by smart use of data systems. Local energy collaborations are a good example of civil society smartness (Ostrom 2010). Citizens exchange data about the use of electricity, so they can form a smart grid that reduces the transport of electricity and hence they contribute to the ambition of more sustainable energy production. The desire to collaborate around the production of sustainable energy has existed for some time but new data systems enable citizens to form low-cost grids and thus take the production of energy into their own hands.

This discussion highlights that these different actors following different logics operate in the datapolis. Forms of smartness can also emerge from interactions between these actors. In Chicago, for example, the civic organization Smart Chicago was set up by the city and several philanthropic organizations (www.smartchicagocollaborative.org). Civil society smartness can also increase when they have access to open government data. Open data usage through a hackathon in Amsterdam, for example, has resulted in a Toilet Finder App that helps people to locate the nearest public toilet (Fitzgerald 2016). Public private smartness increases when government and companies share data. The City of Singapore, for example, stresses that public data infrastructures need to facilitate private commerce (Mahizhnan 1999). A concrete example of public–private collaboration comes from Amsterdam. The City of Amsterdam uses GPS data from an Amsterdam-based navigation software and technology provider to help manage traffic flow in real time (Fitzgerald 2016). This use of data is said to be a big improvement over Amsterdam's existing traffic management model that relied on data from 2011. In sum, these examples highlight that different actors engage in interactions to build urban data infrastructures that contribute to the smartness of the city.

The collaborations between public, private and civil society actors are promising but also raise important issues. Who is to be the owner of the data? How are the profits divided. Meijer and Thaens (2016) discuss these issue for a smart city project in the city of Eindhoven in the Netherlands and identify various tensions between the interests of the different actors. This underlines that it makes a difference which actor constructs the smart city. Governing the datapolis is not only about governing state agencies but also about influencing the interactions between all these actors. The datapolis should not be understood as high-tech government but rather as interactions around data systems between various sorts of actors in cities. Governance of smart cities is not only about making choices about government data but it is also about influencing the variety of urban data that are being generated and used in urban environment. The next section will explore the rules for the governance of the datapolis.

Governance Rules: Perceptions, Power and Decisions

To understand how the smart city is governed, we have to understand the rules that guide the behavior of actors in the datapolis. Smart cities "gurus" focus on instrumental rules: they suggest that new technologies help cities to enforce the rules and thus produce a desirable outcome. The desirability of rule enforcement is taken as a given. Political science scholars, however, stress the city does not have one single set of objectives. Objectives are always challenged and negotiated (Pierre 2011). The Greek concept polis acknowledged this fragmentation: it refers to the community of citizens that seek ways to discuss, negotiate and realize

both individual and collective interests (Hansen 2006; Sternberger 1977). The classic polis is the city state of Athens, where all free male citizens would congregate to discuss the affairs of the city. This model has formed the starting point for modern democratic theory (Dahl 1967); the key question has always been how people in a city should govern themselves. Political and social rules for engagement are at the heart of this political analysis of smart cities.

At the moment, however, the smart city heavily relies on the logics of a technocratic manager. Citizens and politics are largely absent in choices about data structures. The smart city discourse often presents a *managerial perspective* of the city (Townsend 2014). Governing is—in line with the philosophy of New Public Management—reduced to managing. Especially when it comes to domains such as transport, energy and waste, this perspective is quite dominant. IBM, for example, defines a smart city as the use of information and communication technology to sense, analyze and integrate the key information of core systems in running cities (Su, Li, and Fu 2011). Technology is seen as an instrument to realize objectives such as safety, health and accessibility (Button 2002). In addition, the smart city discourse is also driven by an *engineering perspective* on city governance. This perspective has permeated public administration theory in general and urban governance theory in particular (Pierre 2011; White 1927). From this perspective, technology is basically an instrument to be used by public administration to realize the policy program of local government (Salamon and Elliott 2002). Technology is an extension—or even perfection—of the bureaucratic organization (Buffat 2015; Zuurmond 1994).

In her perspective on the study of the public domain, Stone (2012: 35) criticizes the models of politics of managers and engineers and challenges the notion that more data results in better decisions. She highlights that data is ambiguous, interpretive, incomplete and strategically manipulated. In this political perspective, data are not a neutral resource—as the managers and engineers see it—but a political resource. Stone (2012) also challenges the traditional distinction between decision-making by politicians and policy implementation by the administration. She argues normative decisions are taken at every stage of the policy process. For this reason, the notion of a political community of citizens is needed to understand policy implementation. Similarly, Svara (2001) refers to this as the "myth of the dichotomy": politics and administration cannot be separated. Policy implementation is not neutral but needs to be understood as a new effort to influence perceptions, exert power, build alliances, generate passion and gain support. This means a smart city cannot be seen as just the realization of "the goals of the city," rather, it is an effort to intervene in the political dynamics of the city.

This previous discussion highlights that the idea that a smarty city is merely about new tools for realizing policy objectives that result from democratic elections falls short of capturing the political dynamics of these tools. The new tools do not only support interactions but also have the capacity to "change the game." Giddens' (1984) structuration theory can help to understand these changes. Giddens identifies perceptual frames, power constellations and institutional rules and the three building blocks of social structure. The political interactions in cities are influenced by these new technologies in three different ways: changing perceptions, power distributions and decision rules. Orlikowski (1992) builds upon Giddens (1984) idea of structuration. Her key argument is that the interaction between technological features—the "affordances" (Sellen and Harper 2002)—and social structures—perceptions, roles, rules, power relations—result in emergent socio-technical practices. The governance challenges of smart cities can be understood in terms of these dimensions of the process of socio-technical structuration: the datapolis emerges from these interactions. This new concept helps us to focus on the governance implications of the datafication of cities.

The first issue for the governance of smart cities is the governance of urban perception. Orlikowski (1992, 2000, 2007) highlights that technologies change our perceptions of the world. For datafied cities, this means that the city is viewed—nearly exclusively—through data and data are seen as the way to view the city. Kitchin (2014a) highlights data are an epistemology, a way of looking at the world or, more precisely, the accepted way of obtaining knowledge about the world. Datafied cities emphasize the superiority of knowledge through data over knowledge through fragmented experiences. An example from the City of Eindhoven in the Netherlands is the use of noise sensor networks to determine whether the noise of festivals is above the accepted level. This system is now seen at the authoritative source and seen as superior to complaints from citizens based on their individual experiences (Meijer and Thaens 2016). In the logic of this system, there is no problem with noise unless the sensor network indicates that there is. This may be problematic when there are different perspectives on noise that are not measures through these sensors such as the pitch and the bass of festival sounds. The governance challenge is to balance different perceptions of urban problems for a pluriform democracy and not just build upon quantitative data for uniform urban management.

The second issue for the governance of smart cities is the governance of power distributions. Access and control over data become crucial resources in modern cities (Klauser, Paasche, and Söderström 2014). Actors who have access to data may be able to influence the agenda and the decision-making process. Governments have a great variety of data about citizens, and they are using all kinds of sensors and cameras to collect even more data (Meijer and Thaens 2016). At the same time, open data can empower disadvantaged groups and help them to strengthen their political position, as many cities present open data to strengthen citizen engagement (Department of Business, Innovation and Skills 2013). The issue of power and data, however, does not only apply to government data. The position of Airbnb and Uber as urban data platforms changes the balance of power. They have data about people in the city, and they use this data to maximize profit rather than to invest in sustainable relations between people in the city. For example, cities need this data to collect tourist taxes but Airbnb only recently agreed to provide this data (Guttentag 2015). The governance challenge is to guarantee checks and balances in access to information to generate a balance of power between the various groups in the city.

And, thirdly, data systems also result in changes in decision rules. Using data for decisions, policies and implementation is seen as the correct way to act (Kitchin 2014b). Individual signals may not be regarded as a sufficient basis for decisions, and only quantitative evidence is regarded as a rational basis for decision-making in the polis. An example is the growing use of quantitative data for urban planning. The use of all kinds of quantitative data from sensors but also from statistical models form the basis for debates about the future of cities. Alternative ideas may only be regarded as valid if they are supported by a strong evidence base of quantitative data. The smart city is largely presented as an evidence-based city in which decision-making is based on "facts". The governance challenge is to balance quantitative data from technological systems and stories, experiential knowledge and other forms of knowing about the city from different stakeholders as a basis for urban decision-making.

An overview of these shifts is presented in Table 2 below:

The table presents the smart city as a dynamic socio-technical construction. The construction of the "datapolis" can be understood as resulting from perceptions, power constellations and decision rules. At the same time, perceptual frames, power constellations and rules are changed by these technical structures. This double relation is the key feature of structuration (Giddens 1984; Orlikowski 1992) and means that the outcomes are not deterministic but rather local emergent.

The model we have developed highlights the interrelations between data infrastructures, perceptions, power distributions, and decision rules. How we perceive the city, who is more powerful and which rules guide decision-making is the outcome of socio-technical interactions around data. But what is the content of these interactions? In the next section we will elaborate upon the content of strategic interactions in smart cities, and explore the politics of urban data as a set of different governance games.

Governance Games: Politics Of Urban Data

The governance of urban data entails playing different "games" that are related to the different stages of data processing. The various (state, market and civil society) actors in the smart city will try to play these games in such a way that it maximize their preferences for smartness. We can distinguish five governance games that are being played in the datapolis (see Table 3).

Governance Game 1: Data Collection

A key question in the governance of smart cities is which data are to be collected about citizens and urban activities. Earlier research has highlighted the sensitivity of CCTV-systems (Webster 2009) and this may only be compounded by more advanced sensors. Discussions about sensor networks provide an interesting example of the politics of collecting data about the city. Kitchin (2014b) rejects the idea that sensor

Table 2. Dynamics of Governance Rules in the Datapolis

	Urban Data Systems Result From …	Urban Data Systems Changes …	Governance Challenge
Perceptual rules	Perspectives on the city and its key problems determine what data are collected	Perspectives on the city and its key problems—agendas—are influenced by the available data	Balancing different perceptions of urban problems
Power rules	Alliances of powerful actors determine what data are collected about which urban activities	Data are used as a resource in strategic interactions between urban actors	Guaranteeing checks and balances in access to urban information
Decision rules	Rules and regulations determine what data about what urban activities are to be collected	Data become embedded in the (informal) rules for decision-making in the city	Building upon different forms of knowing in urban decision-making

Table 3. Governance Challenges in the Datapolis

Game	Governance Challenge
Data collection	Organize modes of data collection that are effective for tackling urban problems but respect the privacy of citizens
Data storage	Find forms of storage that facilitate smartness while not impinging on legitimate forms of ownership
Data usage	Facilitate usage of data for tackling urban problems while guaranteeing that this does not harm citizens or stakeholders
Data visualization	Provide forms of visualization that facilitate debate with insights while not limiting it by leaving out crucial perspectives
Data access	Enable and stimulate access to data but restricting it in the case of legitimate objections such as privacy and security

networks are neutral. He argues the positioning of sensors in a city to measure air quality, noise levels, traffic congestion, etc. should be understood as political decisions. The citizen network of noise sensors around Amsterdam Airport provides a good example of these politics. The citizens who were in a fight with government, about the level of noise from air traffic, built a network to strengthen their position in political debates (De Lange and De Waal 2013). These citizens were able to strengthen their position in this debate by bringing in the data from their own sensor network.

Governance Game 2: Data Storage

The ownership of data is a key issue when it comes to the governance of data storage. In the debate about smart cities, the ownership over traffic data presents an interesting issue. The use of TomTom traffic data by the police in the Netherlands to determine where to do the speed controls is an interesting example (Bornschlegel 2011). The data about speeding were generated by GPS but owned by TomTom and sold to the police. This resulted in much resistance from customers and TomTom decided to no longer sell these data to the police. In debates about personal data such as medical or school data, there is increasing emphasis on control over data by individual citizens (Li et al. 2010). This highlights the idea that "he who collects the data, also owns the data" is increasingly challenged.

Governance Game 3: Data Usage

The re-use of data for new purposes is a key promise of big data and it is both highly promising but also potentially dangerous. That is why Bollier and Firestone (2010) talk about the promise and peril of big data and this highlights the need for governance of data usage. An important issue in whether big data from social media analysis can be used for public purposes. Social media monitoring has become common practice in government organizations (Kavanaugh et al. 2012) but one can question whether governments can really use these personal data to obtain information about public issues. The police in several countries are struggling with the question to what extent data on social media can be regarded as open sources or whether this should be qualified as forms of digital surveillance that require permission from a district attorney (Trottier 2016).

Governance Game 4: Data Visualization

Data visualizations can have a strong impact on perceptions of the city and therefore proper governance of these visualizations is of great importance. Crime maps are an important example, as they both show crime patterns and also the extent to which crime fighting is effective. Wallace (2009) argues that although these maps are justified using the rhetoric of community empowerment, their design supports a neo-liberal agenda of individual responsibility over safety in the context of outsourced security. They mention the example of enabling users to easily measure the distance between the place where sex offenses take place and where schools are located. This may result in the argument that when offense takes place the parents took the risk by sending their child to a school in the proximity of child offenders. This does not mean that the visualization contains a call for action but it does highlight that certain uses are facilitated.

Governance Game 5: Data Access

Access to data has been a political arena since the 1960s (Robert 2006) and the governance of access has only become more salient in the past decades. Kitchin (2014a: 16) indicates that the open data movement sees open data as a public good ("data wants to be free"), the business community sees it as a valuable commodity that needs to be protected through intellectual property right regimes ("the new gold") and the state sees this data as a means by which political agendas and policy programs can be legitimated ("evidence based policy"). A concrete example of the tensions that may arise comes from Groningen in the Netherlands. In this province there are earthquakes due to extensive gas drilling. These data are of crucial importance for damage claims and political debates but, as RTV

Noord reported on April 12, 2015, both government and gas drilling company are reluctant to release this data. They fear they will not be able to control their image and the resulting claims from citizens.

This overview of different governance games shows the abstract discussion of the nature of data systems becomes quite tangible in the governance of issues such as positioning sensors in the city, ownership over car data, re-use of Facebook posts, visualizations of crime patterns and decisions to open up access to government data. Kitchin (2014a: 16) highlights these issues are not technical but political. Neither of these actors is "right": they all voice different opinions and perspectives on data. Resulting practices should be understood as emerging from political interactions, and strategic games between various actors. The governance games they play are influenced by institutional rules and these rules vary considerably between countries. The urban governance challenge is to ensure that the outcomes of these games are considered to be legitimate by citizens and stakeholders in the city.

Understanding the Governance of Smart Cities as a Strategic Game

The public governance perspective on smart cities—the datapolis—stresses that data-infrastructures embody value judgments about the city and thus are not neutral tools but mechanisms for governing the political community of citizens. The previous sections have highlighted that different types of actors (state, market and civil society), engage in a series of games (data collection, data storage, data usage, data visualization and data access) and follow and change institutional rules (for perceptions, power and decisions). These different elements can now be combined in a public governance perspective on smart cities. The governance of smart cities is re-conceptualized as the socio-technical structures that emerge from the governance games.

The concept we have developed, the datapolis, seems new and the examples of the datapolis we have discussed present a variety of modern gadgets, apps, infrastructures and systems. At the same time, this analysis is not new. Already in 1967, Anthony Downs (1967: 204) wrote in Public Administration Review: "In reality, every change in urban data-reporting or data-processing systems has both technical and power repercussions. Hence, anyone analyzing the impact of automated data systems upon urban decision-making (…) must take both dimensions into account." The perspective we have developed on governing the datapolis acknowledges this foundational work of Downs (1967) and has developed a lens to study these "power repercussions" of data systems.

The notion of a strategic game is well known to governance scholars (Klijn and Koppenjan 2000; Scharpf 1997) but there is a limited understanding of its interrelations with technology. For this reason, we have used theories of technology structuration (Orlikowski 1992) to develop a socio-technical understanding of these strategic games. The notion of structuration forms the basis for the empirical analysis of the governance of smart cities:

- First, we can study how choices for data-infrastructures emerge from dominant perceptions, power alliances, and (institutional) rules. Which actors engage in the development of new systems? How do they perceive the city and urban problems? What role do they envision for the system in urban governance? How do different set of rules influence their interactions?
- Second, we can study how the perceptions, strategic interactions, and rules for decision-making are influenced by data-infrastructures. How are data used in processes of agenda-setting? What is the role of urban data systems in the development of policies and decision-making about urban problems? Do the systems strengthen the power position of certain actors?
- Third, we can study how these interactions between institutional structures and technology result in the emergent properties of smart cities. Can we trace how technologies have been used to strengthen certain modes of perception over time? Do we see how certain coalitions of actors have used the systems to re-define power relations in the city? Have modes of decision-making changed over time through the connection between certain technological logics and interests of actors?

The value of this type of analysis can be shown by applying it to the analysis of the construction of a "smart street" in the Dutch City of Eindhoven (see Meijer and Thaens (2016), for a full description of this case). Technology was used in this city to strengthen the safety management of this street by providing specific insights about when and where certain safety threats such as fights or pickpocketing can emerge. The City of Eindhoven constructed a living lab that collects data from visual and auditive sensors but also social media analysis, private data from mobile telephones and datasets about traffic and parking. An analysis on the basis of the approach that we developed in this article highlights the following:

- How do choices for data-infrastructures emerge from dominant perceptions, power alliances and (institutional) rules? Government and commercial actors engage in the construction of new technologies for urban safety. The model of safety is very much a top–down one: better information is to be used for early intervention and nudging of citizens. The idea that a safe street through early government

interventions and nudging is desirable is taken for granted. In addition, the safe street is an attractive environment for companies to showcase their technologies. Rules for privacy are taken into account to restrict the use of personal data and to focus on aggregate data about groups of citizens on the street.

- How are the perceptions, strategic interactions and rules for decision-making influenced by data-infrastructures? The new data infrastructures in this street in Eindhoven strengthen the position of government in their regulation of safety on this street. Government collects more information about the street and can use this information to legitimize different kinds of interventions. Urban safety is conceptualized as an information problem that can be solved by collecting better information through sensor networks. Legitimate interventions are interventions that are based on data about safety patterns on this street. The safe street also strengthens the position of commercial actors since it legitimizes the idea that public space can be used to test and showcase new technologies.
- How do these interactions between institutional structures and technology result in the emergent properties of smart cities? The emerging pattern of safety is not one in which citizens work with shop and bar owners to discuss how they can assume more responsibility for safety. The emerging structure is a high-tech surveillance structure that puts the responsibility for safety in the hands of government actors and also permits them to develop this type of surveillance structure for a relatively minor problem. At the same time, the emergent structure is also an experimental environment for showcasing new safety technologies.

The example of the smart street in the City of Eindhoven highlights how a perspective on socio-technical interactions in the datapolis helps to understand emerging structures. The perspective of the datapolis invites us to broaden our perspective on data to state, market and civil society data and all kinds of combinations of these logics. We need to study how these various data systems in the city interact to evaluate the outcomes not only in terms of efficiency and effectiveness but also in terms of winners and losers, shifting perceptions of the city and its problems and changing value distributions.

Towards a Democratic Perspective on the Future of Urban Governance

We set out to develop a public governance perspective that can form the basis for a more empirical analysis of the dynamics of smart cities. The current debate focuses strongly either on the engineering perspective—how can these new technologies be used to realize desirable outcomes?—or on the critical perspective—how can we show that big corporate and government interests dominate the construction of smart cities? Both perspectives do not acknowledge the complexities of urban governance and politics. Neither of these two perspectives uses the rich understanding of social interactions with new technologies that has been developed over the past decades. This article set out to build an understanding of smart cities on the basis of a solid theoretical understanding of the interaction between technological and political processes in the public sphere. We introduced the concept of the datapolis as the central focus for the study of the socio-technical dynamics of smart cities.

The public governance perspective we developed stresses that the smart city should be understood as a complex set of interactions between private, public and civil society actors. They all have systems for collecting and processing data and they also exchange and use data from other actors. Governance of the smart city is not only about public structures but about influencing all these interactions in modern cities. This governance is guided by institutional rules. We used Giddens' (1984) work on structuration to highlight that these rules refer to perceptions, power and decisions. These rules guide the governance of new technologies but are also influenced by these technologies (Orlikowski 1992). This means decisions about data in cities have institutional implications. For this reason, the "games" around data are of crucial importance for the future of cities. The actors in the datapolis try to "win" these games to dominate the future of cities. We can thus study the construction of smart cities as a series of connected repeat games between a variety of actors.

The key contribution of this article is that it connects two different "worlds": the technical world of urban data infrastructures, networks of sensors and "smart technologies" and the social world of politics, governance and strategic interactions between a variety of actors in urban environments. The term datapolis bridges these worlds and highlights that urban data infrastructures cannot be understood without studying strategic interactions between different actors and that urban governance cannot be understood without studying the role and impacts of new technologies on these interactions. Urban actors play technological games and these games need to be studied to understand the future of urban governance. These two worlds have been bridged in previous work for organizations (Orlikowski 1992), government agencies (Fountain 2001) and technological systems (Bijker et al. 1987) but not for public—multi-actor—governance of cities. At the same time, the literature on collaborative governance (e.g., Greasley and Stoker 2008;

Klijn and Koppenjan 2000; Kort and Klijn 2011) provides many insights about interactions between actors but pays limited attention to urban technologies. The "bridge" between two empirical worlds is constructed by building on two bodies of literature: the literature on socio-technical systems and the literature on public governance. This combination results in a theoretical understanding of the emergent governance of socio-technical structures in urban environments such as energy, mobility and safety systems.

The public governance perspective on smart cities here is illustrated with a variety of examples in different policy domains. Further research is needed to provide an in-depth analysis of the emergence of these socio-technical structures in the datapolis. The analysis needs to focus on the role of strategic games and the power position of various actors in the development of urban data infrastructures. For comparative research, an important question is how the policy and democratic context influences the development of smart cities. Do we see other patterns for energy problems than for safety? Are smart cities in China very different from those in Western Europe? The perspective of actors, rules and games can help to develop a systematic understanding of these differences.

The concept of the datapolis can form the basis for organizing the democratic legitimacy of smart city practices. The acknowledgement of the social and political nature of the smart city brings to the fore the idea that urban governments need to organize proper mechanisms for connecting citizens to decisions and implementation of data systems in the city. The realization that urban data do not only serve urban management but also urban governance and politics creates the need to politicize seemingly technical choices such as the positions of sensors and contracts about the ownership of data from outsourced processes. A public governance perspective opens up venues for conceptualizing political engagement as a positive force in the city and for citizens and to develop data infrastructures that fit the demands and requirements of citizens. This does not mean that citizens will all have similar positions and interests but it stresses that the data infrastructures are developed on the basis of democratic interactions rather than technocratic considerations. Organizing these democratic interactions in a fair and just way is a key task for public governance and of crucial importance to maintain trust. Put differently: the data infrastructure should be debated in the polis to ensure its long-term legitimacy. The governance challenge is to produce legitimate forms of stimulating the intelligence of the city. In general, legitimacy depends on the contribution of the data to the production of solution of urban problems but also on respect for privacy, data ownership, inclusiveness, etc. The specific meaning of legitimacy needs to be assessed within the context of the games that are being played by real actors. Table 3 presents an overview of these five governance challenges.

The democratic debate about the datapolis can take several forms and can take place with different audiences. Choices for datastructures can be debated in formal elections. The Pirate Party, for example, has been able to demand attention for decisions about technology in the public sector (Erlingsson and Persson 2011). In addition, citizens can be engaged in decisions over and the implementation of specific systems. Citizens can, for example, play a role in decisions about safety cameras and smart software to detect indicators of criminal behavior or in decisions about smart traffic systems that reduce parking problems but may invade on the privacy of individual citizens (Van Zoonen 2016). The datapolis can also be structured to enhance citizen participation through new form of information provision. Foth et al. (2011) stress that urban informatics can be used to stimulate citizen engagement. Both the general debates about larger issues and the debates about specific systems and local forms of participation open up the technocratic discourse about smart cities to public scrutiny and debate about value and perils.

In conclusion, the datapolis is a lens that helps to see that choices for technological systems are determined by social structures but, at the same time, these social structures are influenced by new technologies. This process of structuration is not predetermined but leaves room for social choice (Downs 1967; Kling 1996). In that sense, a datapolis enables us—academics, urban practitioners and citizens—to retrieve the smart city from the technological determinists—the gurus and engineers—who claim to know what the future will bring. This means that it is crucial to study seemingly technological decisions about urban data as political decision-making processes that are crucial to the future of urban governance.

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