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Privacy concerns in smart cities

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ABSTRACT

In this paper a framework is constructed to hypothesize if and how smart city technologies and urban big data produce privacy concerns among the people in these cities (as inhabitants, workers, visitors, and otherwise). The framework is built on the basis of two recurring dimensions in research about people's concerns about privacy: one dimensions represents that people perceive particular data as more personal and sensitive than others, the other dimension represents that people's privacy concerns differ according to the purpose for which data is collected, with the contrast between service and surveillance purposes most paramount. These two dimensions produce a 2×2 framework that hypothesizes which technologies and data-applications in smart cities are likely to raise people's privacy concerns, distinguishing between raising hardly any concern (impersonal data, service purpose), to raising controversy (personal data, surveillance purpose). Specific examples from the city of Rotterdam are used to further explore and illustrate the academic and practical usefulness of the framework. It is argued that the general hypothesis of the framework offers clear directions for further empirical research and theory building about privacy concerns in smart cities, and that it provides a sensitizing instrument for local governments to identify the absence, presence, or emergence of privacy concerns among their citizens.

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1. Introduction and purpose

Local governments across the world are in the middle of technological and economic developments that come together in the catch-all label of 'smart cities'. In a smart city, ICT-infused infrastructures enable the extensive monitoring and steering of city maintenance, mobility, air and water quality, energy usage, visitor movements, neighborhood sentiment, and so on. Evidently, such processes use and produce massive amounts of data. In the Dutch city of Rotterdam, for instance, the traffic authority monitors about 22,000 vehicle movements every morning,[1] while the regional environment agency produces hourly data about air quality from sensors across greater Rotterdam resulting in over 175,000 observations per year. The promise of such large amounts of data for smarter management of cities extends to other sectors as well such as (predictive) policing, crowd control or public sentiment monitoring.

The notion of data, in this context, extends beyond the big numbers churned out by monitoring technologies, but also includes the data present in city registers, the data from government or corporate surveys and the data from social media updates. These data are ever more often combined and linked in order to produce joint indicators of city well-being, economic vitality or safety. Increasingly, local governments make these data also available to the wider public. All of this raises issues about who has legitimate access, which data can be opened up to public usage, what is the appropriate privacy framework for the linkage of different data? In these discussions, issues like political and public acceptance of smart cities are important as is the question of everyday experiences in such 'datafied' cities (Powell, 2014). While some claim that 'big data' will help cities become richer, cleaner and more efficient, others argue that cities will turn into data-driven robotic places where creativity and deviance have no place. Kitchin (2014a) argues that there is little attention for such 'politics of city data' nor for the question how particular practices of data collection and analysis may have problematic social effects. He adds that the ubiquitous collection of data about all city processes may produce 'panoptic' cities, in which "systems that seek to enable more effective modes of governance [may] also threaten to stifle rights to privacy, confidentiality, and freedom of expression" (p 12).

This paper forms part of these debates and starts from the assumption that it is necessary to acknowledge people's concerns about their privacy in the further development of smart cities in order to maintain their support and participation (e.g. Townsend, 2013), as will be explained in more detail in Section 3. Without such an acknowledgement smart city projects have been seen to become controversial and abolished.

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[1] http://www.ad.nl/ad/nl/1012/Nederland/article/detail/3668009/2014/06/06/Fileloze-vrijdag-groot-raadsel-net-zoveel-verkeer-als-anders.dhtml.

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The main purpose of the paper is to develop a framework for exploring people's specific privacy concerns in smart cities on the basis of existing research about people's privacy concerns in general. Two dimensions emerge from the literature: concerns differ with respect to the kind of data that are involved, which can range from personal to impersonal data and all degrees and combinations in-between; and concerns vary along the purpose for which purpose are data used, which can move from improving the livability and services in a city to advancing surveillance and keeping citizens in control. The data and purpose dimensions together form the basis for a 2 × 2 privacy framework in which smart technologies and applications as well as specific forms of data collection and usage can be plotted. The framework is then further explored and illustrated through a discussion of three concrete examples. It is argued that the framework offers an instrument for local governments to understand and incorporate privacy concerns in their policy and operational decisions, and that it offers a set of hypotheses to academic researchers to further conduct research about privacy concerns in smart cities.

2. Data landscapes in the smart city

Powell (2014) uses the term 'data cities' to indicate that 'smart' technologies like transport systems, air quality monitors or CCTV cameras simultaneously use and generate enormous amounts of data. Taylor and Richter (2015) similarly identify (big) data as key to the rise of smart cities. Bettencourt (2014) makes a more specific claim when she says that big data are particularly helpful for more successful urban policies and planning. Kontokoska (2015) speaks in this respect of computational urban planning. Both big data discourse and smart city discourse tend to obscure that data have always been crucial to city planning and city life. Cities started monitoring their populations mostly in the 19th century as part of the wider movement towards modern means of governing the nation state (e.g. Breckenridge & Szreter, 2012). Partly through civil registrations, partly through bureaucratic and commercial records, partly through surveys and mapping, the 19th century saw a similar data avalanche as we are witnessing today and data since has come to underpin city planning and decisions. Robertson and Travaglia (2015), therefore, claim that the current big data wave constitutes a difference of speed and size, but not one of analytic principle and relevance.

To date, such reflections on the historical and present-day importance of data for city management do not include a systematic inventory of the kinds of data involved. While it is not the purpose of this paper to provide such a catalogue, to understand the variety of privacy concerns at stake it is necessary to have at least a preliminary impression of the diversity of data that are used in and by cities. The table below presents such an impression for the city of Rotterdam in the Netherlands. It is based on the discussions, interactions and projects taking place in the Urban Big Data Lab, a collaboration of two Rotterdam universities and local government aimed at optimizing the understanding and usage of big, open and linked data for city policies and planning.[2]

While the above table is likely to be incomplete and imbalanced, it does convey the diversity of data in smart cities. Data differ in size, in regularity, in purpose, in complexity, in ownership, in visibility, and other matters. Moreover, within big cities oversight of these different data and streams tends to be lacking (cf. Meijer & Rodríguez Bolívar, 2015). City data emerges from a wide variety of governmental departments, from private and public stakeholders, from individual citizens and visitors, and are collected, analyzed and stored without any kind of central coordination or collaboration. Kaisler, Armour, Espinosa, and Money (2013) conclude that data diversifies and multiplies at unprecedented and unplanned speed, requiring ever bigger and multiple storage facilities and diverse and combined analytic techniques, while engaging different actors who tend to lack knowledge of each other let alone collaborate.

The complexity of the city data landscape has led many cities to appoint chief data officers who are responsible for the usage and management of data; in New York, in particular, a Mayor's Office of Data Analytics was established in 2013. Towns (2014, no page) provides the rationale for these decisions by saying that cities "have struggled to share and integrate data streams in ways that support comprehensive analysis. Issues around data ownership, as well as privacy laws and public perception, have been significant stumbling blocks."

3. Bringing citizens into the picture

The emerging city data landscape provides local governments with additional challenges as well. Al Nuaimi, Al Neyadi, Mohamed, and Al-Jaroodi (2015), for instance, identify five concrete, operational issues with respect to data, i.e. sources, sharing, quality, security, privacy and costs. (e.g. Kitchin, 2014a) takes a critical perspective and shows how the discourse around big data and smart cities produces a suggestion of data providing neutral information for rational governance, while hiding the political and corporate interests. In a similar vein, Söderström, Paasche, and Klauser (2014) analyze how the term 'smart city' has become a key theme in corporate storytelling, and argue for alternative understandings of smart cities that take public interests into account. Viitanen and Kingston (2014) provide a concrete analysis of problems that local governments face when confronted with a corporate push to adopt smart data technologies and big data applications, and show how there is a serious risk of following the imperatives of the market instead of the demands of public policy. According to Datta (2015), Kitchin (2014b) and Vanolo (2013), such public policy should, among other things, consider the uneven pace at which cities become smart. As is clear from the academic literature and even clearer from the explosion of conferences, seminars, networks, blog posts and social media updates, the development and the discourse around smart cities is carried by an urban 'tech-elite' of IT corporations, young, well-educated, mostly white and male professionals, and a-political aspiring city managers. In fact, anecdotal evidence suggests that the whole notion of 'smart city' or 'big data' and what it entails may be unknown to the majority of current city inhabitants and visitors (Thomas, Mullagh, Wang, & Dunn, 2015). Reflecting on Barcelona, March and Ribera-Fumaz (2014, p.1) argue therefore that it is imperative to "put citizens back at the center of urban debate".

Various suggestions have been made and explored to integrate a wider group of citizens into smart city design and policies, – for instance – through citizen participation (Berntzen & Johansson, 2016), crowd sourcing (Schuurman, Baccarne, De Marez, & Mechant, 2012), citizen-centered approaches (Gaved, Jones, Kukulska-Hulme, & Scanlon, 2012), or co-creation and living labs (Schaffers et al., 2011). Others have argued more generally for a stronger protection of the privacy of citizens living, working, shopping or travelling in a smart cit. Li, Dai, Ming, and Qiu (2015) identify the over-collection of data as a severe security risk, especially when it comes to the sensitive data that people hold on their smart phones. Martinez-Balleste, Perez-Martinez, and Solanas (2013) similarly fear for the privacy of citizens in smart cities, especially when it comes to protecting information about their identity, the kind of information they look for, their location, energy usage and possessions (see also Bartoli et al., 2011). Privacy scholars offering solutions to privacy risks in smart cities focus on particular technological solutions, such as cloud computing (Kahn, Pervez, & Ghafoor, 2014), privacy enhancing technologies (PETs, Rebollo-Monedero, Bartoli, Hernández-Serrano, Forné, & Soriano, 2014) or transparency enhancing technologies (TETs, Beran, Pignotti, & Edwards et al., no year). Policy makers have turned to privacy impact assessments as a tool to identify whether a specific technology or applications involves a privacy risk and how this can be mitigated (cf. Wright & De Hert, 2011).

[2] See http://www.kenniswerkplaats-urbanbigdata.nl/.

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