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Problematizing data-driven urban practices: Insights from five Dutch 'smart cities'

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ABSTRACT

Recently, the concept of the smart city has gained growing popularity. As cities worldwide have set the aim to harness digital technologies to their development, increasing focus came to lie on the potential challenges and concerns related to data-driven urban practices. In the existing literature, these challenges and concerns have been dominantly approached from a pragmatic approach based on the a priori assumed 'goodness' of the smart city; for a small group of critics, the very notion of the smart city is questionable. This paper takes the middle-way by interrogating how municipal and civil society stakeholders problematize the challenges and concerns related to data-driven practices in five Dutch cities, and how they act on these concerns in practice. The lens of problematization posits that the ways of problematizing data-driven practices contribute to their actual enactment, and that this is an inherently political process. The case study shows that stakeholders do not only perceive practical challenges but are widely aware of and are (partly) pro-actively engaging with perceived normative-ethical and societal concerns, leading to different (sometimes inter-related) technological, legal/political, organizational, informative and participative strategies. Nonetheless, the explicit contestation of smart city policies through these strategies remains limited in scope. The paper argues that more research is needed to uncover the structural-institutional dynamics that facilitate and/or prevent the repoliticization of smart city projects.

1. Introduction

In the past two decades, cities around the world have started to devise and implement 'smart' urban visions that promote the use of digital technologies and data to address urban policy issues related to air and water quality management, energy usage, mobility or public safety, amongst others (Hollands, 2008; Manville et al., 2014; Van Zoonen, 2016). While the 'smart city' label has resisted a straightforward definition, analysts have converged on interpreting it as a development concept that is strategically invested by urban stakeholders to make cities more sustainable, efficient and competitive, as well as livable (Allwinkle & Cruickshank, 2011; Angelidou, 2014; Kitchin, 2014; Sikora-Fernandez, 2018). Contrasting overly optimistic claims about the benefits of the smart city, policy-makers and academics increasingly recognized that data-driven urban practices give raise to technological and management challenges, as well as to normative-ethical and societal concerns. These (varyingly) skeptical viewpoints within the broader discourse of smart urbanism form the starting point of the present paper.

Studies principally approving of smart city-building (see Kummitha & Crutzen, 2017) have dominantly framed the discussion in terms of challenges related to data characteristics, data processing techniques and data management (Batty, 2013; Cretu, 2012; Sivarajah, Kamal, Irani, & Weerakkody, 2017) or in terms of business or technological challenges (Hashem et al., 2016; Lee, Gong Hancock, & Hu, 2014). Analysts have acknowledged challenges related to privacy, security and ethics, but have paid relatively little attention to them and have considered them to be (relatively easily) 'solvable' (Hashem et al., 2016; Marrone & Hammerle, 2018; Martínez-Ballesté, Pérez-Martínez, & Solanas, 2013). For critically-minded scholars in turn, ethical-normative and societal-equity concerns have stood central, related to issues such as privacy (Townsend, 2014), monitoring and surveillance (Kitchin, 2014, 2016; Klauser, Paasche, & Söderström, 2014), predictive profiling and social sorting (Lyon, 2003; Van Zoonen, 2016), behavioral nudging (Kitchin, 2016), a bias towards technocratic, 'solutionist' policy-making (Kitchin, 2014), the (further) undermining of genuine citizen participation (Cardullo & Kitchin, 2017; Gabrys, 2014), or the privileging of IT business interests (Grossi & Pianezzi, 2017; Hollands, 2015; Wiig, 2015). Critical scholars have thus signaled issues that, according to them, are not straightforwardly resolved, if at all.

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Drawing on strands of critical theory such as Foucault's work on governmentality (e.g. Vanolo, 2014) or Deleuze's ideas on the society of control (Krivý, 2016), some have even questioned the very rationale and contribution of smart cities (Kummitha & Crutzen, 2017).

This paper discusses smart city-related challenges and concerns without siding with the dominant pragmatic, problem-solving approach, or with critical, theory-driven perspectives. Rather, aligning with more nuanced critiques that have urged for engagement with the empirical field (Kitchin, 2015; Van Zoonen, 2016), it argues that one should interrogate how involved actors themselves problematize the challenges and concerns related to data-driven practices. Reporting on exploratory, qualitative research into stakeholders' assumptions and understandings of data-driven urban practices in five Dutch smart cities, the paper argues that this problem-driven approach (Glynos & Howarth, 2007) helps getting a better grip on the politics of smart city building (Kitchin, 2015; Meijer & Bolívar, 2016).

The remainder of the paper is organized as follows. The next section (Section 2) discusses the lens of policy problematization and its merits in smart city research. Subsequently, the case study context and the methodology are explained (Section 3), to be followed by the findings from the empirical case study (Section 4). The paper concludes by discussing the findings (Section 5) and by reflecting on avenues for future research and practice (Section 6).

2. Policy problematization as an analytical strategy

'Problematization' is a variously used term in social scientific research; here, it refers to the concept's increasingly influential, Foucauldian-inspired application in critical policy studies (Bacchi, 2012; Clarke, 2017; Glynos & Howarth, 2007; Howarth, 2005; Webb, 2014). For this scholarship, policy is 'unpredictable, chaotic, and contradictory' (Webb, 2014, p. 369) and is not directed at pre-given objects and problems but is co-constituting the latter. To quote Foucault, problematization is the "ensemble of discursive and nondiscursive practices that make something enter into the play of true and false and constitute it as an object of thought" (Foucault, 1988, p. 257). For Foucault, studying problematizations was crucial to "dismantle" objects as taken- for-granted fixed essences (Foucault in Bacchi, 2012, p. 2), and to see how particular solutions to a problem were not simply constructed, but how they resulted from particular forms of problematization (Foucault, 1997, pp. 118–119).

In critical policy studies, the notion of problematization has been used to shed light on how and why problems and solutions are being articulated and enacted within certain registers rather than others (Webb, 2014, p. 369). As Bacchi has argued, the lens of problematization helps make "politics […] visible" (Bacchi, 2012, p. 1). In concrete research, a focus on the situated practices helped reveal how key policy actors' representation of problems is contingent upon a range of dilemmas they encounter in their daily activities (Clarke, 2017). Applying a hermeneutic approach, the researcher's task here is to "provide second-order interpretations of social actors' own self-understandings and interpretations of their situations and practices" (Heidegger, in Howarth, 2005, p. 319). At the same time, as policy problems are not reducible to actors' discourses, actors' self-understandings need to be contextualized (Glynos & Howarth, 2007), i.e. examined within the constellation of social relations (Clarke, 2017) and the broader structural-institutional conditions that have given rise to and have shaped the problems in question (Howarth, 2005). How certain issues become problematized is thus shaped by the interplay of structure and agency. Social agents are 'thrown into' a system of practices that shapes their identity and structures their actions, yet never in a fully deterministic fashion (Glynos & Howarth, 2007) as agents reflect on a repertoire of options and deal with arising dilemmas (Davies & Msengana-Ndlela, 2015). Agency is thus conceptualized as a series of uncertain and situated responses to ambiguous discourses and practices of power (Zanotti, 2013). On the other hand, institutions and practices are assumed to be partly shaped by actors' desires and actions (Howarth, 2005). Importantly, the poststructuralist assumptions of the lens of problematization imply that researchers are (also) "always already within a world of meaningful objects and practices" and thus cannot approach their object of study in an atheoretical and independent fashion (Howarth, 2005).

Approaching smart city-related challenges and concerns through the lens of problematization is based on the assumption that data-driven practices are fundamentally political and shaped by diverse forms of socially constructed knowledge (Luque-Ayala & Marvin, 2015; Meijer & Bolívar, 2016). From this point of view, the 'smart city' does not have an essence that can be captured by 'evidence' (cf. Angelidou, 2016) but is an 'open concept' (Kooij, Van Assche, & Lagendijk, 2014) invested with multiple (possibly conflicting) meanings by different actors connected by complex relations of power and (inter)dependence. The added value of this perspective is that it helps *repoliticizing* smart city-building by highlighting how the 'actually existing smart city' (Shelton, Zook, & Wiig, 2015) is always a product of (conscious and unconscious) choices of actors along particular normative values and favoring certain interests rather than others (Meijer & Bolívar, 2016).

Research into the problematization of policy issues can usefully start by interrogating what Martin and Waring (2018) call 'critical intermediaries' who are "active in the process of translation of [smart city] discourse into practice, interrogating prescribed policies, finding their strengths and weaknesses" (p. 12). In the case of smart city projects, municipal policy officials and civil society organizations act as such intermediaries: they assume a key role in adapting and embedding the smart city discourses and products propagated by tech-companies (Söderström, Paasche, & Klauser, 2014; Wiig, 2015) into the individual subjectivities and collective routines of urban communities. Their understanding of data-driven urban practices, including the challenges they entail, has a crucial influence on the actual unfolding of smart urbanism and merits further analysis.

3. Case study context and methodology

The empirical findings presented here stem from a multiple-case design research project on smart city building in the five largest Dutch municipalities: Amsterdam, Rotterdam, The Hague, Utrecht and Eindhoven (hereafter: G5). The focus on these cities was chosen as the first four have a longstanding collaboration in a platform called G4 with regard to innovative urban policies; Eindhoven was added because of its 'high-tech profile' and its explicit ambition to become a smart city. The Netherlands' national smart city strategy (Wamelink, 2017) has also assigned a leading role to the G5 municipalities in specific fields of smart urban development (Amsterdam = circularity, Rotterdam = resilience and energy transition, The Hague = safety and security, Utrecht = healthy urban living, Eindhoven = smart mobility). Finally, a sample of five cities is a good basis to highlight how various concerns related to smart city projects are being dealt with across a variety of municipal institutional contexts.

The empirical data collection, undertaken from February until the end of July 2017, was based on iterative steps of desk research focusing on relevant policy documents, and fieldwork including semi-structured in-depth interviews with key informants and participative observation at smart city-related events. In total, six smart city professionals working for local government (one in each city, except in The Hague where two interviews were conducted), and five working in civil society organizations were interviewed. As to the former, contact was sought with officials who have been most intensively involved in smart city building. Smart city professionals in civil society organizations (one in each city) working on the interface between culture, science and technology were recruited through snowballing techniques. The organizations themselves were included following two criteria: 1) active involvement of citizens with data-driven practices in their respective municipality; 2) a reflexive attitude towards smart city building. On this

basis, the following organizations were selected: Waag Society Amsterdam, Creating010 Rotterdam, ICX The Hague, SETUP Utrecht and DATAstudio Eindhoven.

Methodologically, Foucauldian discourse analysis (FDA) (Sharp & Richardson, 2001) and Laclau and Mouffe's discourse theory (DT) (Howarth, 2010) were combined as these are consistent with the lens of problematization (see e.g. Bacchi, 2012; Howarth, 2005). Notwithstanding their differences, these two approaches converge on studying the construction of meaning and its effects in terms of relational systems of ideas, objects and practices that are called discourses (Müller, 2011; Torfing, 2005). Furthermore, as poststructuralist-inspired approaches, both FDA and DT focus on questioning presuppositions (rather than on producing 'true knowledge', the idea of which they dismiss) and they hold that analysts are themselves embedded in the discursive field under study (rather than being neutral observers, see Jørgensen & Phillips, 2002). Also, they do not provide a neutral set of universal techniques that can be applied mechanically (Howarth, 2005). Consequently, poststructuralist discourse analytical approaches have often been criticized for being sloppy and for lacking scientific relevance. However, provided the analyst has a reflexive attitude, the computer-aided analysis of discourses can enhance the transparency and openness of the research process (see e.g. Van den Brink, 2009). In the present study, the software ATLAS.ti was used to code (and re-code) all data (documents, interview transcripts, field notes), and it assisted in determining the final categories on which the reported findings are based. Finally, it should be noted that similar to other qualitative approaches, FDA and DT should not be assessed along traditional (positivistic) notions of reliability and validity, but in terms of coherence and fruitfulness (Jørgensen & Phillips, 2002) or, according to others, in terms of trustworthiness, rigor and quality (Golafshani, 2003). In line with this and to minimize researcher bias, informant feedback and investigator triangulation were used at key points of the project.

4. Findings

4.1. Smart city projects in the five largest Dutch municipalities: an overview

The empirical fieldwork inventoried smart city-related projects in the G5. To help the apprehension of the discussion of empirical findings in subsequent sections, Table 1 presents a selective overview, including only those projects that were most often mentioned by respondents when discussing the challenges and concerns related to data-driven urban practices.

4.2. Perceived challenges and concerns about the smart city

During the interviews, an open-ended approach was applied so as to learn about stakeholders' own assumptions and understanding of data-driven urban practices, including the challenges they perceive and the concerns they have, without foregrounding certain topics. Table 2 offers an overview of the issues that were most often mentioned by respondents. This overview is indicative and should not be interpreted too closely because of the relatively small sample size. Also, although the overview does indicate whether a concern was voiced by either municipal officials or civil society organization representatives (or by both/neither), it does not say anything about the 'weight' with which each concern was mentioned. The above reservations aside, some broad observations can be made.

The most commonly mentioned concerns were related to privacy; in fact, privacy was often a starting point and umbrella-term for talking about smart city related concerns. The belief that datafication would make urban problems more knowable and solvable was unanimously criticized by interviewees, showing thus a critical attitude towards the 'goodness' of the smart city. Urban dashboards were concretely mentioned as tools that reduce complex phenomena to a few numbers without any interpretation. As it was put: "*[…] you are then trying to catch a complex reality in models and you go measure it. But what comes out of these measurements is not necessarily a good reflection of what is happening in real life*" (Creating010 Rotterdam). Furthermore, a municipal official pointed out that especially infrequent problems would be harder to detect with data-driven practices: "*There is a city where the suicide rate amongst women is much higher than in other cities. […] So that is a problem that would not exist in the standard data-driven methodologies because it is no big data. That leads to disastrous decision-making and is a disastrous way of looking at society*" (Municipality of The Hague). Relatedly, several respondents raised concerns about the fact that (big) data are socially constructed and thus arbitrary: "*So you could say that an algorithm is a magic box that produces a certain outcome […]. But […] an algorithm is made by people and those people make choices*" (Municipality of Utrecht). Also, concerning the biased nature of (big) data it was noted that "*bias may create a too simple picture and lead to policies that do not match with the real world*" (Municipality of The Hague). A possibly problematic bias was also signaled in connection with smart city projects' focus on the physical domain (e.g. road traffic) where data are more abundantly present than in the social domain (e.g. health care) (Municipality of Amsterdam). Finally, data-driven practices were criticized for mainly addressing the symptoms of urban problems, but not their causes. As one respondent argued, installing rain sensors for cyclists at traffic lights might benefit cyclists but excludes the policy alternative of a car-free city center (Creating010 Rotterdam). The proportionality of data-driven projects was sometimes also criticized when much effort had been invested in data assembly, analysis and application, without significant results.

Despite shared concerns, civil society representatives were generally more critical about smart city development than municipal officials. For example, municipal respondents noted that open data portals were heavily underutilized; civil society organizations, on the other hand, pointed out that the data citizens would be interested in were not

Table 1
A selection of smart city projects in the G5 municipalities.

City	(Focus of) smart city project(s)	Content
Amsterdam	Smart mobility	Pressure-sensitive sensors at loading zones and bus stops that generate data for digital signs to limit parking time
Rotterdam	Bicycle rain sensors	Rain sensors at two crossings, allowing for longer green times of the cycling traffic in the case of rain or snow
Eindhoven	De-escalate/Stratumseind 2.0	Use of IoT (weather, noise and visitor-counting) sensors and social media data (measuring positive/negative emotions) to predict fights in the nightlife area of Stratumseind, and to nudge visitors into more calm behavior by adjusting the intensity and/or color of lighting
Utrecht	Data-driven bicycle storage	IoT-sensors in the bicycle storages (cameras counting free spots), which are linked to digital signs in the city center that show the number of free spots
Eindhoven	City beacon project	Smart lamp posts in the city center featuring IoT-sensors, a touch-screen visitor information screen, WIFI-connection, lighting and an advertising screen
The Hague	Healthy longer at home (iZi Livinglab)	Testing digital technologies (robots, smart home domotics and senior-tablets) in a nursing home for their ability to assist the elderly in living independently for a longer time.
The Hague	Smartbox	A social benefit fraud prediction project combining datasets from the municipality's department of Social Affairs and Employment to assess the risk of recipients committing fraud.

Table 2
Key concerns related to data-driven smart city projects in the G5 (A = Amsterdam, R = Rotterdam, H = The Hague; U = Utrecht, E = Eindhoven) X = mentioned by municipal official; Y = mentioned by civil society organization representative.

Focus of concern	Explanation	A	R	H	U	E
Data availability and access to data (tools)	The functioning of data-driven practices often depends on what data and digital technologies are available/ accessible, and to whom	X Y	X Y	X Y	Y	X Y
Quality of data	Limitations in data validity, reliability, representativeness and interoperability	Y	X Y	X Y	X Y	Y
Security of data infrastructures	Cyberattacks, system crashes and data leaks threaten the functioning of data-driven practices	X Y	X Y		X Y	
Socially constructed nature (and arbitrariness) of data	Data-driven practices are not neutral, but are formed by choices and constraints in a specific social context		Y	X Y	X Y	
Limitations of datafication	Not all urban problems are equally knowable and solvable by means of data driven practices, so the proportionality of this should always be questioned	X Y	Y	X Y	X Y	X Y
Privacy	The private sphere of citizens may be threatened by data-driven practices through revealing their identity or sensitive information about them	X Y	X Y	X Y	X Y	X Y
Autonomy	Behavior of citizens can be steered by means of digital control mechanisms without their knowledge or approval, which dehumanizes them and removes agency	X Y		Y	Y	Y
Fairness	Data-driven practices may lead to the unequal treatment of citizens by categorizing people and/or exclude certain citizens	Y	Y	X Y	X Y	Y
Transparency	Data-driven practices are typically invisible to citizens and increasingly difficult to check up on by experts	Y	Y	X Y	X Y	Y
Corporate power	The commodification of data-driven practices makes urban governance dependent on IT companies; urban policies may become biased towards business interests	Y	X Y	X Y	Y	X Y

available or accessible to them. The issue of autonomy was noticeably more often brought up by civil society representatives, with several of them sketching a dystopian future scenario in which invisible algorithms take away our autonomy. The lack of transparency has been criticized as well; as it has been pointed out, it is often nearly impossible for individuals not directly involved in the project to find out what data are actually assembled, how they are analyzed and to what end. For example, the project at Stratumseind in Eindhoven was mostly invisible on the street: "*At the beginning of the area where you are monitored, there is a sign with a camera on it. But no words, only a symbol of a camera. Supposedly you are all informed then.*" (DATAstudio Eindhoven). As to municipalities' take on the issue, the Municipality of The Hague justified their lack of transparency by pointing out that they first want to figure out internally how to deal with the various concerns emerging related to smart city projects; making pilot projects more public was feared to lead to media outrage over (racial) profiling and the municipality "*did not yet have the answers to all questions*". Similarly, although the potentially distorting effects of private sector interests were brought up as an important issue by each municipal respondent, they also noted that municipalities had become increasingly dependent on IT and data analyzing companies (Municipality of Rotterdam).

4.3. Strategies to address smart city-related concerns

This section discusses the (variously explicit) strategies that the above-discussed concerns have induced in the G5 by grouping them along the aspect on which they focus (see Table 3). It should be noted that the 'types' of strategies mentioned here are not distinct categories but are intertwined in practice; also, this five-fold typology is not exhaustive as there might be other strategies.

4.3.1. Technological strategies

Technological strategies address issues related to data accessibility, quality and security by providing standardized data registration, preparing datasets to make data openly accessible, checking data for quality and error margins as well as securing data storage. In all five municipalities, having a separate data-department or at least specialized staff, such as computer scientists and information managers, appeared essential to implement such strategies and to prevent dependence on IT companies for setting up data-driven projects. More specific technological strategies included privacy-by-design, where during the development of a technology and its appropriation in a project it is ensured that no personal data can be collected. The underlying principle is data minimalization, i.e. only those data are collected which are absolutely necessary for the purpose of the project. For example, the project of data-driven bicycle storage in Utrecht counted empty spots by means of IoT-enabled cameras without storing the video footage. Furthermore, municipal respondents have also mentioned value sensitive design, such as when personal data are collected, the dataset is being anonymized through the decoupling of personal data from other types of data or through the aggregation of the dataset to a higher level (e.g. group or neighborhood). As some have emphasized, it is very important to document all choices and limitations during processes of data assembly, analysis and application, thereby making the social construction of data more transparent (Municipality of The Hague). Finally, instead of merely having an open data portal online, several municipalities aspire to develop a data library where supply and demand for data may be brought together. This is expected to increase the availability and access to data: "*[…] we proposed […] a kind of library where you can go to, and where someone helps you to find your data. It also defines the requirements for using the data and technicalities like standards and billing mechanisms. In fact, one exchange system for open, commercial, or semi-commercial data, real-time or periodic*" (Municipality of Rotterdam).

4.3.2. Legal and political

Recent regulatory changes, in particular the European General Data Protection Regulation (GDPR), were often referred to by respondents as an important step towards safeguarding public interests in smart cities. The GDPR obligates multiple mitigation strategies such as privacy-by-design and the documentation of choices and limitations during the design of data-driven projects; as such, the GDPR enables the implementation of different precautionary measures. On the national level, regulatory compliance is monitored by organizations like the Data Protection Authority (privacy) the National Cyber Security Center (security of data infrastructures), and the Dutch Standardization Forum (quality of data, in particular interoperability). The Data Protection Authority (2016), for instance, warned municipalities that abuses of the Dutch Data Protection Act by invasive wifi-tracking in public space might result in legal penalty, including fines. Advertising companies using cameras in digital billboards received similar warnings (Verhagen, 2018). Municipalities also use their competence to introduce legal safeguards on the local level. For example, the producer of Eindhoven's City beacon project and the city's marketing agency

Table 3
Strategies used to deal with concerns related to smart city development in the G5.

Type of strategy	Actors involved	Examples
Technological	- IT and software companies - Technical engineers and designers - Data and computer scientists, statisticians - Information management	- Privacy-by-design - Anonymization of data - Data library
Legal and political	- Government and elected politicians - Lawyers and legal advisers - Regulatory agencies	- Laws and regulation at different scales - Oversight and supervision, queries on behalf of the public
Organizational	- Project team - Data protection officer - Policymakers - Executive professionals	- 'Carwash method' - Privacy impact assessment, societal cost-benefit analysis, ethics toolkit - Using complementary qualitative data - Learning by doing from pilots
Informative	- Project team - Civil society organizations - Media, artists and designers - Citizens	- Information material in clear language - Websites, books, documentaries - Playful activities
Participative	- Project team - Civil society organizations - Citizens	- Participative design - Tinkering with digital technology and data

wanted to claim all collected data. However, the municipality developed open data principles and turned these into local regulation to make sure that "*data collected in public space are public property*" (Municipality of Eindhoven).

Legal strategies are closely interlinked with political ones as it is in the political domain that legal regulation related to data-driven practices is negotiated and enacted. Furthermore, governments are held accountable for safeguarding public interests. Colleges of mayor and aldermen were indeed often named by municipality officials as showing the direction that smart city development takes in practice. For example, the open data principles in Eindhoven and later in Amsterdam were the initiatives of aldermen. City councils were seen to fulfil an important role by asking critical questions when necessary: "*Privacy is very hot. Really hot. So, when there is only the slightest suggestion that something is not well with privacy, then the city council is on top of it*" (Municipality of The Hague). Some elected politicians have also proactively shaped smart city projects by initiating queries on behalf of the public. For example, Councilwoman Fatima Faïd of The Hague City Party asked critical questions about a social benefit fraud prediction project (Bertram & Van Aartsen, 2014), in particular about the variables used in the system and who decided about this. She criticized that visiting the same holiday country had been considered as a risk factor in data analysis; according to her, this could lead to more false positives in predicting a risk on fraud for residents with an immigrant background, since they might regularly visit family in their country of origin. Also, Faïd questioned the fairness and proportionality of using data-driven practices in this way. In defense, the college of mayor and aldermen argued that variables had been selected by municipality officials based on earlier successes in detecting fraud, that visiting the same country was just one variable that contributed to a combination of risk factors, and that current resources for detecting fraud were inadequate.

4.3.3. Organizational

An important task for G5 smart city project teams has been to check with policymakers and executive professionals which data-driven practices are both feasible and meaningfully addressing urban problems. This was described by a respondent as the 'carwash method'. Acting as information brokers between municipality departments, smart city program managers found out which data could be used to develop policy solutions, thereby also facilitating a cross-sectoral approach. Moreover, they slowed down or stopped projects that were initiated merely because of the 'trendiness' of digital technologies and also refused to cooperate with companies that use data as their direct business model instead of providing a service or product.

While having a data protection officer is mandatory by European Union law from 2018 on, most municipalities already employed at least one person to safeguard the security of data infrastructures and privacy protection at the time of research, and privacy impact assessments (PIA) had been used to examine possible issues with data-driven projects. Some municipalities had taken further steps: the city of Utrecht, in collaboration with the Utrecht Data School at Utrecht University, devised a comprehensive 'tool-kit' (including a poster, app and guideline) for assessing and reflecting on smart city issues. Several municipalities aimed to tackle the perceived limitations of datafication by considering other forms of knowledge, such as qualitative data and the interpretations of policymakers and executive professionals. In Eindhoven, a designer was hired to retrieve 'soft data' from neighborhoods and to talk to residents, "*thereby effectively mapping what is going on*" (Municipality of Eindhoven). The municipality of Utrecht organized regular 'knowledge circles' for policymakers and executive professionals to allow them discussing their views on the functioning of data-driven projects. Finally, research participants commonly perceived the organizational form of pilot projects as an advantage for safeguarding public interests. Both municipality officials and civil society organizations described how 'learning by doing' through experiments allowed for learning about possible downsides of data-driven practices and reflecting on possible solutions. Nonetheless, according to one of the civil society respondents, the ethical implications of living labs (in particular the question of obtaining informed consent from participants) needs more explicit consideration (DATAstudio Eindhoven).

4.3.4. Informative

Several respondents noted that the transparency of data-driven practices has become more important with the introduction of automatic technologies such as algorithmic decision-making. The publication of information material that employs clear language and explains how data comes about or how data is being collected was mentioned by many as the first step. Table 4 contains some examples as to how vague language use could be turned more transparent in data-driven projects according to respondents. Civil society organizations have been actively involved in bringing smart city issues under the attention of municipality officials and residents. One respondent developed various websites (socialcooling.com, mathwashing.com and technologiebeleid.nl) that explain issues of privacy, autonomy and fairness in relation to data-driven practices. Several municipality officials mentioned watching documentaries or reading books that are critical about smart city practices, such as Frank Pasquale's 'Black box society' (2015).

Moreover, municipalities and especially civil society organizations initiated ludic and playful activities to make data-driven practices more transparent. During 'data walks' led by an expert in Rotterdam (Van

Table 4
Respondents' examples of vague and transparent use of language in explaining data-driven projects.

Vague	Transparent
Sniffing pole	Air quality sensors
Bang sensors	Digital microphones that register noises such as (illegal) firework
Bicycle parking sensors	Digital cameras that count the empty parking spots without storing footage

Fig. 1. Playful project 'Taste your status' by Vincent Hoenderop at the symposium 'more data' at the Netherlands Study Centre for Technology Trends on 9 March 2017.
Source: Author's own photo material.

Zoonen, Hirzalla, Engelbert, Zuiderwijk, & Schokker, 2017), participants were asked to identify points in public space where data might be assembled or applied, and then to discuss the likely purposes and social actors 'behind' these practices. These walks raised participants' awareness of the manifold data points present in the urban landscape (from public transport check-in posts to security cameras and from ATM machines to stickers identifying Wi-Fi access) and enabled them to interactively disentangle data-driven practices with the help of the expert guide. Another playful activity organized by a civil society organization (SETUP Utrecht) intended to make people aware of the potentially discriminatory character of big data: at a symposium, visitors were offered 'good' or 'bad' tasting coffee depending on the neighborhood they live in, whereby the social status of the neighborhood was retrieved from a database of Statistics Netherlands (see Fig. 1).

4.3.5. Participative

One of the most mentioned participative strategies was what one respondent described as participative design. Project teams played an important role in this strategy by finding out the needs and concerns of residents about specific data-driven practices. For example, in the Healthy Longer at Home project of the Municipality of The Hague, a test panel of elderly was involved to regularly discuss their needs and concerns, and only those technologies were selected that were in line with these. In negotiations between the elderly panel and the project team it was eventually decided that no data would be collected to safeguard privacy: "*The idea was first to make this project about data collection with sensors so that we could use it in dashboarding the city. I prevented that and said no, because we are dealing here with the most personal data there is*" (Municipality of The Hague). Including elderly residents as participants was praised by civil society organization ICX The Hague arguing that the elderly were not the 'typical' target group of smart city projects. A research participant of DATAstudio Eindhoven mentioned how their workshop with residents in the neighborhood Woensel-Noord also employed participative design. More specifically, it was discovered how contact frequency was an invalid measure for loneliness amongst elderly residents as the experience of loneliness had to do more with contact intensity.

Improving the accessibility of data-driven practices and counterbalancing corporate power were explicit goals of a second participative strategy: tinkering with digital technology at events like hackathons and data bootcamps where residents could try crafting something with open data or sensor equipment, usually guided by a technical specialist. Civil society organizations especially perceived tinkering as a way of teaching citizens some skills which are usually only reserved for experts: "*Being able to make air quality sensors, work with DNA-material, start coding with children. These are all ways to get a grip on the technological society*" (Waag Society Amsterdam).

5. Conclusion

This study inquired into how stakeholders, more specifically municipal officials and representatives of civil society organizations engaging with smart city projects, have problematized data-driven urban practices in five selected Dutch cities. The underlying assumption was that by examining, through the lens of problematization, these actors' perceptions of smart city challenges and how they act on these concerns, we can gain insight into the political construction of the actually existing smart city.

Our findings portray the reflective usage of specific projects to talk about smart city related concerns, even when respondents were not specifically asked for examples. It appeared that although civil society representatives are typically more critical of data-driven practices than municipality officials, the latter also problematize various aspects of smart city building. While 'privacy' is often used as an umbrella-term for discussing smart city related concerns, other challenges (e.g. the limitations of datafication) are noticed as well, leading to a range of strategies.

The results of this study confirm thus Kitchin's (2015) remark that stakeholders do not uncritically embrace smart city projects but are open to critical dialogue; furthermore, often they pro-actively criticize the interpretation of the smart city as a technology-led urban utopia. Rather than perceiving the smart city as a magic bullet, or simply focusing on practical challenges, they tend to have a more critical view, challenge smart city projects on ethical-normative grounds and question the very merits of data-driven approaches. However, although this attitude has given rise to various strategies that actively steer smart city development, the extent to which stakeholders' problematizations are conducive to the contestation of dominant smart city discourses appears limited or, in any case, unclear. The reflective-yet-approving stance of municipal actors can be best captured by the notion of 'hybridized

engagement' (Zanotti, 2013): stakeholders are neither simply subjected to smart city discourses, nor do they rebel against them outright, but they are variously appropriating and tinkering with them. It is remarkable that even though their anonymity was granted, several municipal respondents showed (initial) reluctance to disclose details about smart city projects and to voice criticisms, fearing that that would harm their municipalities' image. In this light, their capacity (willingness) to openly contest smart city developments certainly needs to be questioned. Civil society representatives appeared to be more critical intermediaries and have assumed a crucial role in educating citizens to 'the logic of smart cities' (Cardullo & Kitchin, 2017). Nonetheless, one should note the lack of reflection from their part on how seemingly progressive intentions might remain conditioned by the neoliberal ethos of entrepreneurialism and self-sufficiency. Hackathons, for example, might eventually feed business-led smart urban development (Cardullo & Kitchin, 2017), and assistance to the elderly to live longer independently is arguably (partly) informed by 'neoliberalist ideals of less state and more individual responsibilities' (Van Hees, Horstman, Jansen, & Ruwaard, 2015).

6. Reflection on implications for research and practice

Given the relatively small sample of respondents, the study reported on here could only offer preliminary insights into the politics of the smart city. On the other hand, from the discourse-analytical perspective on problematization, the focus is on those situated within the discourse of interest (see Starks & Brown Trinidad, 2007), and more specifically, on those who are in a powerful position to shape that discourse. Municipal policy officials and civil society organizations play a key role in enacting smart city discourses; arguably, their accounts allow thus for a first approximation of how problems related to the smart city are thought of. To further our understanding, these insights would need to be complemented, first, by an inquiry into how members of the broader 'epistemic community' of smart cities, i.e. practitioners who through their (net) work shape the implementation of (smart) urban policies (Kitchin, Coletta, Evans, Heaphy, & MacDonncha, 2017), problematize data-driven urban practices. This should be further extended by an investigation of the problematization of the smart city by other actors such as citizens and businesses. These problematizations need then to be contextualized to reveal the actual social logics (path-dependent institutional dynamics, power relations, dominant schemes of interpretation) (Glynos & Howarth, 2007) that facilitate or prevent the actual contestation of smart urban policies. Furthermore, there is a need for comparative studies that examine how actors' problematizations and the extent to which they take effect differ across different local contexts.

With the above comments in mind, this paper does not only have the aim to inform scholarly debates but – in particular through its overview of possible strategies to address smart-city related concerns – also smart city practitioners. Importantly, despite being analytically distinguishable, the strategies mentioned here are not distinct categories but are intertwined in practice: privacy concerns, for instance, are embedded in European and local regulations that necessitate privacy-by-design, which in turn could be implemented through learning by doing or participative design, while informing the public through playful activity. Furthermore, the strategies presented are not intended as 'evidence-based policy recommendations' (Angelidou, 2016) or as propositions for 'a more professional pursuit of the smart city concept' (Bergh van den & Viaene, 2016, p. 5.) – this would be at odds with the perspective of problematization taken here which aims at revealing the (implicit) political choices that shape smart city projects. Our paper will hopefully incite practitioners who devise data-driven urban practices to take a more reflexive stance from which the taken-for-granted directions and benefits of smart urbanism can be put under ongoing, critical scrutiny.

Declaration of Competing Interest

None.

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References

Allwinkle, S., & Cruickshank, P. (2011). Creating smart-er cities: An overview. *Journal of Urban Technology, 18*(2), 1–16.
Angelidou, M. (2014). Smart city policies: A spatial approach. *Cities, 41*(1), S3–S11.
Angelidou, M. (2016). Four European smart city strategies. *International Journal of Social Science Studies, 4*(2), 18–30. https://doi.org/10.11114/ijsss.v4i4.1364.
Bacchi, C. (2012). Why study problematizations? Making politics visible. *Open Journal of Political Science, 2*(1), 1–8. https://doi.org/10.4236/ojps.2012.21001.
Batty, M. (2013). Big data, smart cities and city planning. *Dialogues in Human Geography, 3*(3), 274–279. https://doi.org/10.1177/2043820613513390.
Bergh van den, J., & Viaene, S. (2016). Unveiling smart city implementation challenges: The case of Ghent. *Information Polity, 21*(1), 5–19. https://doi.org/10.3233/IP-150370.
Bertram, A. W. H., & Van Aartsen, J. J. (2014, 15 July). Beantwoording schriftelijke vragen van het raadslid mevrouw F. Faïd [Answers to written questions by councilwoman F. Faïd]. Retrieved from https://denhaag.raadsinformatie.nl/document/3774978/1/173RIS272843_Den_Haag_bijstandsfraude_opsporen_met_big_brother_systeem.
Cardullo, P., & Kitchin, R. (2017). Being a 'citizen' in the smart city: Up and down the scaffold of smart citizen participation (The programmable city working paper 29). Retrieved from osf.io/preprints/socarxiv/v24jn.
Clarke, A. (2017). Analyzing problematization as a situated practice in critical policy studies: A case study of 'customer focus' policy in urban compliance services. *Critical Policy Studies*. https://doi.org/10.1080/19460171.2017.1414619.
Cretu, L. (2012). Smart cities design using event-driven paradigm and semantic web. *Informatica Economică, 16*(4), 57–67. available at http://www.revistaie.ase.ro/content/64/07%20-%20Cretu.pdf.
Data Protection Authority (2016, 15 June). Wifi-tracking en de Wet bescherming persoonsgegevens [Wifi-tracking and the Dutch Data Protection Act]. Retrieved from https://autoriteitpersoonsgegevens.nl/sites/default/files/atoms/files/brief_ap_vng_wifi-tracking.pdf.
Davies, J. S., & Msengana-Ndlela, L. G. (2015). Urban power and political agency: Reflections on a study of local economic development in Johannesburg and Leeds. *Cities, 44*, 131–138. https://doi.org/10.1016/j.cities.2014.09.001.
Foucault, M. (1988). *Politics, philosophy, culture: Interviews and other writings, 1977–1984.* New York, NY: Routledge.
Foucault, M. (1997). *Ethics.* New York: New Press.
Gabrys, J. (2014). Programming environments: Environmentality and citizen sensing in the smart city. *Environment and Planning D: Society and Space, 32*(1), 30–48. https://doi.org/10.1068/d16812.
Glynos, J., & Howarth, D. (2007). *Logics of critical explanation in social and political theory.* London: Routledge.
Golafshani, N. (2003). Understanding reliability and validity in qualitative research. *The Qualitative Report, 8*(4), 597–606.
Grossi, G., & Pianezzi, D. (2017). Smart cities: Utopia or neoliberal ideology? *Cities, 69*, 79–85. https://doi.org/10.1016/j.cities.2017.07.012.
Hashem, I. A. T., Chang, V., Anuar, N. B., Adewole, K., Yaqoob, I., Gani, A., ... Chiroma, H. (2016). The role of big data in smart city. *International Journal of Information Management, 36*(5), 748–758. https://doi.org/10.1016/j.ijinfomgt.2016.05.002.
Hollands, R. G. (2008). Will the real smart city please stand up? Intelligent, progressive or entrepreneurial? *City, 12*(3), 303–320. https://doi.org/10.1080/13604810802479126.
Hollands, R. G. (2015). Critical interventions into the corporate smart city. *Cambridge Journal of Regions, Economy and Society, 8*(1), 61–77. https://doi.org/10.1093/cjres/rsu011.
Howarth, D. (2005). Applying discourse theory: The method of articulation. In D. Howarth, & J. Torfing (Eds.). *Discourse theory in European politics: Identity, policy and governance* (pp. 316–349). Basingstoke: Palgrave Macmillan.
Howarth, D. (2010). Power, discourse, and policy: Articulating a hegemony approach to critical policy studies. *Critical Policy Studies, 3*(3–4), 309–335.
Jørgensen, M. W., & Phillips, L. J. (2002). *Discourse analysis as theory and method.* London: Sage.
Kitchin, R. (2014). The real-time city? Big data and smart urbanism. *GeoJournal, 79*(1), 1–14. https://doi.org/10.1007/s10708-013-9516-8.
Kitchin, R. (2015). Making sense of smart cities: Addressing present shortcomings. *Cambridge Journal of Regions, Economy and Society, 8*(1), 131–136. https://doi.org/10.1093/cjres/rsu027.
Kitchin, R. (2016). Reframing, reimagining and remaking smart cities. (The programmable city working paper 20). Retrieved from https://osf.io/cyjhg/.
Kitchin, R., Coletta, C., Evans, L., Heaphy, L., & MacDonncha, D. (2017). Smart cities,

urban technocrats, epistemic communities and advocacy coalitions. *The programmable city working paper 26*. Retrieved from http://progcity.maynoothuniversity.ie/2017/03/new-paper-smart-cities-urban-technocrats-epistemic-communities-and-advocacy-coalitions/.

Klauser, F., Paasche, T., & Söderström, O. (2014). Michel Foucault and the smart city: Power dynamics inherent in contemporary governing through code. *Environment and Planning D: Society and Space, 32*(5), 869–885. https://doi.org/10.1068/d13041p.

Kooij, H.-J., Van Assche, K., & Lagendijk, A. (2014). Open concepts as crystallization points and enablers of discursive configurations: The case of the innovation campus in the Netherlands. *European Planning Studies, 22*(1), 84–100. https://doi.org/10.1080/09654313.2012.731039.

Krivý, M. (2016). Towards a critique of cybernetic urbanism: The smart city and the society of control. *Planning Theory*. https://doi.org/10.1177/1473095216645631 Advance online publication.

Kummitha, R. K. R., & Crutzen, N. (2017). How do we understand smart cities? An evolutionary perspective. *Cities, 67*, 43–52. https://doi.org/10.1016/j.cities.2017.04.010.

Lee, J. H., Gong Hancock, M., & Hu, M.-C. (2014). Towards an effective framework for building smart cities: Lessons from Seoul and San Francisco. *Technological Forecasting and Social Change, 89*, 80–99. https://doi.org/10.1016/j.techfore.2013.08.033.

Luque-Ayala, A., & Marvin, S. (2015). Developing a critical understanding of smart urbanism? *Urban Studies, 52*(12), 2105–2116. https://doi.org/10.1177/0042098015577319.

Lyon, D. (2003). *Surveillance as social sorting: Privacy, risk, and digital discrimination.* London: Routledge.

Manville, C., Cochrane, G., Cave, J., Millard, J., Pederson, J. K., Thaarup, R. K., ... Kotterink, B. (2014). *Mapping smart cities in the EU.* Brussels: European Parliament, Directorate-General for Internal Policies, Policy Department A: Economic and Scientific Policy.

Marrone, M., & Hammerle, M. (2018). Smart cities: A review and analysis of stakeholders' literature. *Business & Information Systems Engineering, 60*(3), 197–213. https://doi.org/10.1007/s12599-018-0535-3.

Martin, G. P., & Waring, J. (2018). Realising governmentality: Pastoral power, governmental discourse and the (re)constitution of subjectivities. *The Sociological Review, 66*(6), 1292–1308. https://doi.org/10.1177/0038026118755616.

Martínez-Ballesté, A., Pérez-Martínez, P. A., & Solanas, A. (2013). The pursuit of citizens' privacy: A privacy-aware smart city is possible. *IEEE Communications Magazine, 51*(6), 136–141. https://doi.org/10.1109/MCOM.2013.6525606.

Meijer, A., & Bolívar, M. P. R. (2016). Governing the smart city: A review of the literature on smart urban governance. *International Review of Administrative Sciences, 82*(2), 392–408. https://doi.org/10.1177/0020852314564308.

Müller, M. (2011). Doing discourse analysis in critical geopolitics. *L'Espace Politique, 12*, 1–18.

Pasquale, F. (2015). *The black box society.* Cambridge, MA: Harvard University Press.

Sharp, L., & Richardson, T. (2001). Reflections on Foucauldian discourse analysis in planning and environmental policy research. *Journal of Environmental Policy and Planning, 3*(3), 193–209.

Shelton, T., Zook, M., & Wiig, A. (2015). The 'actually existing smart city'. *Cambridge Journal of Regions, Economy and Society, 8*(1), 13–25. https://doi.org/10.1093/cjres/rsu026.

Sikora-Fernandez, D. (2018). Smarter cities in post-socialist country: Example of Poland. *Cities, 78*, 52–59.

Sivarajah, U., Kamal, M. M., Irani, Z., & Weerakkody, V. (2017). Critical analysis of big data challenges and analytical methods. *Journal of Business Research, 70*, 263–286. https://doi.org/10.1016/j.jbusres.2016.08.001.

Söderström, O., Paasche, T., & Klauser, F. (2014). Smart cities as corporate storytelling. *City, 18*(3), 307–320. https://doi.org/10.1080/13604813.2014.906716.

Starks, H., & Brown Trinidad, S. (2007). Choose your method: A comparison of phenomenology, discourse analysis, and grounded theory. *Qualitative Health Research, 17*(10), 1372–1380.

Torfing, J. (2005). Discourse theory: Achievements, arguments, and challenges. In D. Howarth, & J. Torfing (Eds.). *Discourse theory in European politics* (pp. 1–32). London: Palgrave Macmillan.

Townsend, A. M. (2014). *Smart cities: Big data, civic hackers, and the quest for a new utopia.* New York: W. W. Norton & Company, Inc.

Van den Brink, M. A. (2009). *Rijkswaterstaat on the horns of a dilemma.* Delft: Eburon Uitgeverij BV.

Van Hees, S., Horstman, K., Jansen, M., & Ruwaard, D. (2015). Conflicting notions of citizenship in old age: An analysis of an activation practice. *Journal of Aging Studies, 35*, 178–189. https://doi.org/10.1016/j.jaging.2015.09.001.

Van Zoonen, L. (2016). Privacy concerns in smart cities. *Government Information Quarterly, 33*(3), 472–480. https://doi.org/10.1016/j.giq.2016.06.004.

Van Zoonen, L., Hirzalla, F., Engelbert, J., Zuiderwijk, L., & Schokker, L. (2017, May 26). 'Seeing more than you think': A 'data walk' in the smart city [blog post]. Retrieved from https://www.bangthetable.com/blog/data-walk-in-smart-city/.

Vanolo, A. (2014). Smartmentality: The smart city as disciplinary strategy. *Urban Studies, 51*(5), 883–898. https://doi.org/10.1177/0042098013494427.

Verhagen, L. (2018, 27 June). Camera's in een reclamezuil? Hoho, dat gaat zomaar niet [Cameras in an advertising pillar? You can't do that just like that]. *De Volkskrant,* 12.

Wamelink, R. (Ed.). (2017). *NL smart city strategy: The future of living.* The Hague: Rehms Druck.

Webb, P. T. (2014). Policy problematization. *International Journal of Qualitative Studies in Education, 27*(3), 364–376. https://doi.org/10.1080/09518398.2012.762480.

Wiig, A. (2015). IBM's smart city as techno-utopian policy mobility. *City, 19*(2–3), 258–273. https://doi.org/10.1080/13604813.2015.1016275.

Zanotti, L. (2013). Governmentality, ontology, methodology: Re-thinking political agency in the global world. *Alternatives: Global, Local, Political, 38*(4), 288–304. https://doi.org/10.1177/0304375413512098.

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