

# 9 Urban data and city dashboards

## Six key issues

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### Introduction

In this chapter we examine six key issues with respect to how we come to know and manage cities through urban data and city dashboards. We seek to provide an agenda for critically reflecting on urban dashboards by examining six related questions:

- 1 How are insight and value derived from city dashboards?
- 2 How comprehensive and open are city dashboards?
- 3 To what extent can we trust city dashboards?
- 4 How comprehensible and useable are city dashboards?
- 5 What are the uses and utility of city dashboards?
- 6 How can we ensure that dashboards are used ethically?

We start, however, by answering a more prosaic question: what are city dashboards?

City dashboards use visual analytics – dynamic and/or interactive graphics (e.g. gauges, traffic lights, meters, arrows, bar charts, graphs), infographics and icons, maps, 3D models and augmented landscapes – to display and communicate information about the performance, structure, pattern and trends of cities. In effect, key data about cities – related to urban systems and infrastructure, society, economy, environment, population, etc. – are displayed on a screen, updated as new data are released and, in many cases, can be interacted with (e.g. selecting, filtering and querying data; zooming in/out, panning and overlaying; changing type of visualization or simultaneously visualizing data in a number of ways) (see Figure 9.1). In some cases, key data are ‘consolidated and arranged on a single screen so the information can be monitored at a glance’ (Few 2006: 34). Analytical dashboards are more extensive in scope and are hierarchically organized to enable a plethora of interrelated dashboards to be navigated and summary-to-detail exploration within a single system (Dubriwny and Rivards 2004). Both types of dashboard are common in urban control rooms, but they are also increasingly being displayed in mayor’s offices and public buildings and made accessible to the general public via dedicated websites.

Typically, city dashboards display seven kinds of data. First, public administration data generated by local government, state agencies and government

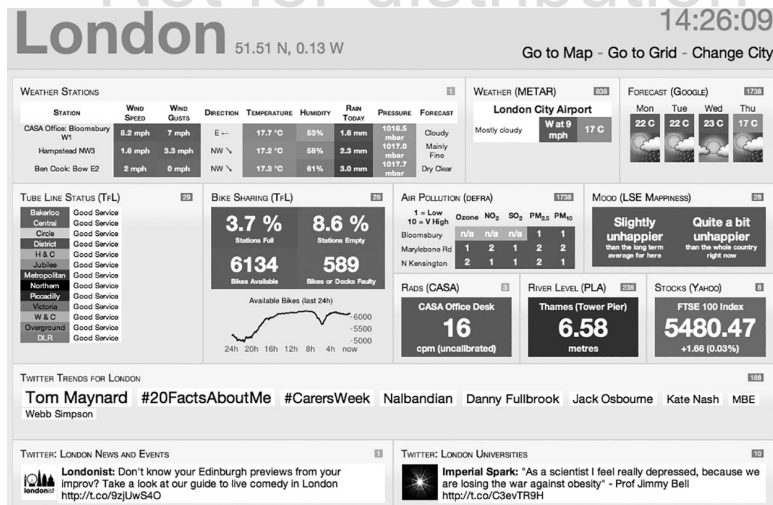


Figure 9.1 City dashboards: (a) Dublin (an analytical dashboard), (b) London (a city at a glance dashboard)

departments (e.g. housing, planning, education, welfare records, budget information). Second, official statistical data typically generated through surveys (e.g. a census or household/business surveys) undertaken by a national statistical institution or compiled from public administration data. Third, operational data concerning the delivery of services by local government or specific agencies (e.g. road usage or repair, the collection of garbage). Fourth, scientific data relating to environmental conditions (e.g. weather, water levels, pollution, noise). Fifth, crowd-sourced data provided by citizens (e.g. reporting incidents). Sixth, locative and social media data (e.g. geo-referenced data from social media, such as Twitter, accessed via APIs). Seventh, derived data – that is, data that are created by combining and analysing the other four types of data (e.g. composite indicators, forecasts/predictions, benchmarks). Typically, most data within city dashboards – especially of the analytical variety – are traditional in their ontology. That is, they are sampled data generated on a set schedule (e.g. monthly, annually). Increasingly, however, city dashboards are incorporating big data, especially with respect to operational and scientific data. That is, data that are produced in real-time by sensors, actuators, meters, transponders, cameras and computational devices, but also through crowd-sourcing and locative and social media.

The use of urban indicator and city dashboard projects have grown in use since the early 1990s, driven by: the rise of new managerialism and the desire to reform the public sector management of city services; citizen and funder demands for evidence-based decision-making; the calls for open data to provide greater accountability and transparency of service delivery; and the development of smart city initiatives that seek to develop data-driven urbanism (Innes and Booher 2000; Holden 2006; Behn 2014; Kitchin *et al.* 2015). City dashboards are becoming increasingly popular with city governments and agencies because they collate diverse sets and streams of indicator and big data into one system and provide tools to visualize, query and analyse them. In particular, they allow a user to track and compare over time and space, and in the case of real-time data, the here-and-now of different phenomena. As such, they permit the following questions to be answered: how is the city performing with respect to key concerns? What are the spatial/temporal patterns of different phenomena? How do different parts of the city compare or how does a city compare with other cities? What is happening in the city right now?

To date, city dashboards have received little critical attention. In the remainder of this chapter we consider the epistemology, scope and access, veracity and validity, use and utility, usability and literacy, and ethics of city dashboards. Our analysis draws on an engagement with the wider literature and our own experiences of building the Dublin Dashboard, an analytical dashboard for the city.

## Epistemology

What are the underlying scientific assumptions of city dashboards? How do dashboards work to generate insight and value? These are epistemological questions. Dashboards utilize visualizations and visual analytics in order to make data about

a city legible and interpretable. Visualizations have long been used to summarize and describe data sets because they effectively reveal and communicate the structure, pattern and trends of data and their interconnections. Digital visualizations can also be used to navigate and query data, enabling users to gain an overview of the entire data set, zoom in on items of interest, filter out uninteresting data, select and query an item or group of data, view relationships among data, and extract sub-collections (Shneiderman 1996). These actions are particularly useful for making sense of very large data sets, revealing structure, clusters, gaps and outliers that might otherwise remain hidden. Visualizations can also be used as a form of analytical reasoning. Here, a visualization is not simply describing or displaying the data, but is used as a visual analytical tool to extract information, build visual models and explanation, and to guide further statistical analysis (Keim *et al.* 2010). Often several different types of visual graphics are used in conjunction with each other so that the data can be examined from more than one perspective simultaneously. In addition, data mining and statistical modelling, such as prediction, simulation and optimization, can be performed and outputted through visual interfaces and outputs (Thomas and Cook 2006). In the context of city dashboards, this epistemology is framed within the emerging field of urban informatics (Foth 2009) and urban science (Batty 2013).

Visual analytics, urban informatics and urban science – and thus city dashboards – adopt a realist epistemology that supposes the existence of an external reality which operates independently of an observer and which can be objectively and accurately measured as quantitative data and be tracked, statistically analysed, modelled and visualized to reveal the world as it actually is. In other words, urban data can be abstracted from the world in neutral, value-free, objective and mechanical ways and are understood to be essential in nature; that is, fully representative of that which is being measured (they faithfully capture its essence and are independent of the measuring process) (Desrosières 1998; Porter 1995). And these data when analysed in similarly objective ways reveal the truth about cities. As such, dashboards have scientific utility because they seemingly translate the messiness and complexities of cities into rational, detailed, systematic, ordered forms of knowledge; they enable a city to be known and explained and to assess how it is performing in a neutral, comprehensive and common-sense manner (Mattern 2014; Kitchin *et al.* 2015).

Such a framing has been criticized for being too closely aligned with positivist thinking, being reductionist, mechanistic, atomizing, essentialist, deterministic and parochial, collapsing diverse individuals and complex, multidimensional social structures and relationships to abstract data points and formulae (Mattern 2013; Kitchin *et al.* 2015). It also wilfully ignores the metaphysical aspects of human life which are difficult to capture as data suitable for inclusion in a dashboard and generally ignores the role of politics, ideology, social structures, capital and culture in shaping cities (Kitchin 2014b). Indeed, they generally deal with facts, not with intangibles, processes, and complex, multi-scalar phenomena, and if used in isolation they decontextualize a city from its history, its political economy, the wider set of social, economic and environmental relations, and its

wider interconnections and interdependencies that stretches out over space and time (Craglia *et al.* 2004; Mori and Christodoulou 2012).

Moreover, it has been contended that city dashboards do not simply present urban data, but actively produce meaning, generating new visions and understandings of a city that re-shape policy formulation and decision-making. As such, a dashboard is not simply a mirror of a city (with varying levels of methodological imperfections and noise), but acts as a translator by setting the forms and parameters for how data are communicated, interpreted and acted upon (Kitchin *et al.* 2015). This translation is ideologically framed and inherently political, reflecting design decisions framed within its development context (Kitchin *et al.* 2016). Their makers might envisage them as detached, passive, neutral scientific instruments that communicate the world as is (as can best be scientifically measured, processed and analysed), or recognize their issues and practise a form of strategic essentialism, but dashboards are the product of the ideas, instruments, practices, contexts, knowledges and systems used to generate, process and analyse them and they actively frame and do work in the world (Kitchin 2014a; Kitchin *et al.* 2015). They are underpinned by normative assumptions about what should be measured and what should be revealed.

This epistemological critique is not to say that city dashboards do not produce valuable insights or are not useful. As noted above visual analytics do produce interesting knowledge about cities and, as discussed below, this knowledge can be deployed in the management and governance of cities. But it is to say that dashboards are not objective, neutral mirrors of cities and need to be understood as producing a particular kind of knowledge that has a number of shortcomings and silences that need to be appreciated and taken into account. As the following sections document, these limitations extend beyond epistemology.

### Scope and access

How comprehensive and open are city dashboards? The first part of this question concerns the scope of the data included in a city dashboard. The second concerns the extent to which a dashboard and the data it displays are open to dashboard builders and the wider public.

In general, dashboards process and display factual, quantitative data; that is, data such as counts, rates, monetary value and scientific measurements that are numeric in format. Much of these data are generated recurrently meaning they can be tracked over time/space and are thus termed ‘indicator data’. Indicators can be direct in nature (e.g. measuring R&D spend to reflect investment in innovation) or indirect (e.g. using a proxy, such as the number of patents registered). Composite indicators combine several indicators using a system of weights or statistics to create a single value, recognizing that most phenomena (e.g. social deprivation) are interrelated and multidimensional and cannot be captured through a single measure (Maclaren 1996). Similarly, urban big data are generally structured, recurrent quantitative measures.

The scope of the data that dashboards display is thus limited. This means that there is an enormous amount of information about cities that are not displayed in

city dashboards. Indeed, as noted, there is a diverse range of everyday activities, forms of urban living, and the nature of the human urban condition that are difficult to capture as indicator data. There are also significant gaps and silences in the data that are displayed. Quantified measures are typically narrowly defined, sampled and non-exhaustive (do not represent all people, places, times) and aggregated (variance is suppressed). Even with big data it is important to appreciate that there remains, and will continue to remain, an unevenness in the deployment of technologies that generate them (e.g. not everyone has a smartphone or uses smart cards). In addition, there are data sets that are chosen not to be included, for example, data that are considered to be political sensitive or embarrassing (e.g. homelessness or service delivery performance). Further, those data that are used are strongly shaped by the technologies and instruments (e.g. the quality and calibration of a sensor) used to generate them which prescribe their parameters and form.

A second limitation concerns access and whether the data that are generated are available for re-use. Up until recently all forms of data used within city dashboards have been relatively difficult to access. Government data were typically locked inside institutions and when made available their use was restricted by cost, copyright and licensing arrangements (Kitchin 2014a). This situation is starting to change with the move to open data, though it is clear that the level of openness varies across administrations and places (Lauriault and Francoli 2016). Data generated by private institutions continues to be a valuable asset and is generally not available for use without a licence – consequently much of the deluge of urban big data is not available for city dashboards (though some companies enable a limited amount of data to be accessed through an API). And when public institutions are privatized, their data are often similarly privatized and become closed (see Chapter 15).

Even when data are available there are often issues related to data measurement (e.g. different agencies using alternate instruments, sampling strategies or classification schemes), data formats and media (e.g. data being released in alternate file types or forms difficult to process such as pdfs), metadata (that is, data about the data concerning lineage, characteristics and quality, which are often missing), data standards (e.g. different agencies using alternate data and metadata standards), lack of methodological guides or data dictionaries to define categories and explain codes, and modes of sharing (e.g. different forms of API). This can make it tricky to process and manage data and to compile comparable and interoperable data sets.

Further, the dashboard itself might not be openly accessible, being used operationally by an organization but not shared publicly. And in cases where the dashboard is made publicly available, the underlying data might not be open to access for re-use, only being presented for viewing/analysis. In some cases, this is because the framework data (e.g. base maps) are used under licence (which might be the case if the base mapping data are sourced from a national mapping agency) or because the attribute data (e.g. indicators) are. Similarly, the software used to create the dashboard might be propriety (produced by a company and used under

licence or provided as a service) or be open source. The Dublin Dashboard, for example, presently uses a mix of open and propriety software tools. All of the city dashboards we are aware of have a closed form of development and governance, meaning that how they are formulated, their underlying algorithms, data sources and how they are run has limited scrutiny.

### Veracity and validity

To what extent can we trust city dashboards? This question refers to data quality and veracity, the appropriateness of the methods used and the validity of the analysis produced by and interpretation drawn from a dashboard.

A common warning related to data analysis is ‘garbage in, garbage out’. In other words, if the data used in a dashboard have little veracity, then the analysis presented has little validity. All data sets contain instrument and human error and bias; generating data always involves a process of abstraction (capturing particular measurements from the sum of all possible data), representation (converting what is being measured into a readable form; e.g. numbers, a wave pattern, a scatterplot, a stream of binary code, etc.), and often generalization (e.g. into a set of categories) or calibration (transformation to compensate for suspected error/bias). They are produced and shaped by technical instruments of varying specification and parameters, handling procedures, scientific norms and standards, scientist behaviour and organizational processes. While a fact seems immutable it is important to note that they are produced, not simply measured (Bowker and Star 1999). For example, how unemployment is calculated varies across jurisdictions and changes over time, with each new formula producing a different rate. Calculating the population of a city seems straightforward but varies depending on who are selected for inclusion/exclusion (e.g. seasonal migrants) or where the boundary of the city is drawn. Likewise, altering the relative weightings of data in composite indicators can have a profound effect on the resulting score (Gruppa and Moge 2004). There are then with every data set concerns about data veracity and quality.

Ideally, these concerns should be minimized through well designed and tested processes of data generation and handling and be documented so that others using the data are aware of any issues (McArdle and Kitchin 2016). Indeed, the importance of reporting data quality is recognized by all scientific bodies. For example, the International Cartographic Association (ICA) details seven key data quality metrics that should be documented in relation to spatial data (which are often used in city dashboards) (Guptill and Morrison, 1995):

*Lineage:* The history of the data including details of the source material and any transformations or processes applied in order to produce the final data.

*Positional accuracy:* An indication of the horizontal and vertical accuracy of the coordinates used in the data, both to absolute and relative locations. It must account for the processes applied to the data which are described by the lineage.

*Attribute accuracy:* The accuracy of the quantitative and qualitative data attached to the spatial data.

*Completeness:* The degree to which spatial and attribute data are included or omitted from the data sets. It also describes how the sample is derived from the full population and presents the spatial boundaries of the data.

*Logical consistency:* The dependability of relationships within the spatial data.

*Semantic accuracy:* The quality with which geographical objects are described in accordance with the selected model. Semantic accuracy refers to the pertinence of the meaning of the geographical object rather than its geometry.

*Temporal data:* The date of observation, the type of update and the validity period for the data.

Data quality issues are also mandated by several ISO standards, such as ISO 19115-1:2014 and 19157:2013. These standards do not indicate acceptable thresholds for quality data, but rather mandate the metadata that needs to be generated with respect to data veracity in order to receive the standard (McArdle and Kitchin 2016).

Nonetheless, despite big data being known to be messy and dirty in nature (Mayer-Schonberger and Cukier 2013), some have argued that using big data does not require the same standards of data quality and veracity as traditional data because the exhaustive nature of the data set removes sampling biases and compensates for any errors, gaps, inconsistencies or weakness in their fidelity of the data. For example, Mayer-Schonberger and Cukier (2013: 13) contend that ‘more trumps better’. Helland (2011) suggests that with very large data sets “‘good enough’ is good enough”. And Franks (2012: 211) argues that big data just needs to be ‘clean enough data’. But what is good enough or clean enough data? And can we trust such data to underpin critical decisions about city policy, investments and public safety? What we really require is big data to have the same levels of veracity as traditional data sets, to have and comply with their own ISO standards, and for this information to be available as metadata. At present, such veracity measures cannot be determined for big urban data.

In fact, it is difficult to establish the veracity of much of the data that are made available through open data sites and displayed in city dashboards. This is because the data used in city dashboards have no or limited data quality metadata, or such metadata is not shared. Nor do they detail the process through which raw data are manipulated for publication. For example, the Dublin Dashboard includes no metadata beyond source and timeliness. One is simply asked to trust that the data have veracity and validity.

Similarly, one is also asked to trust that the visual analytics and any calculations and modelling undertaken are valid. As most methods in textbooks highlight, it is relatively straightforward to either unintentionally or deliberately lie or mislead with statistics and maps. How data are transformed and presented can make a significant difference to how they are interpreted. Ecological validity concerns the legitimacy of making inferences based on the outputs presented.





Figure 9.2 Mapping the same data at three different administrative scales

One of the most common types of ecological fallacy created within city dashboards is the Modifiable Areal Unit Problem (MAUP) (Openshaw 1984), wherein the statistical geography used to display aggregate data can have a marked effect on the pattern of observations. For example, Figure 9.2 displays the same housing vacancy data in three statistical geographies, producing varying patterns and interpretation. Likewise, altering the classification boundaries, or altering the number of classes, can have a similar effect. In other words, it is possible to draw very different conclusions depending on how the data are aggregated and presented. Similarly, the choice of analytics and models, and the selection and tweaking of parameters within them, can produce markedly different results. Yet how a calculation or model is formulated is often black-boxed, meaning that its workings are not made available to others to assess or to replicate. In these cases, users are asked to trust that the analytics are producing valid analysis which leads to sensible interpretation.

### Usability and literacy

How comprehensible and useable are city dashboards? There is an assumption that city dashboards – especially those that are publicly available – enable a suite of urban data to be explored, analysed and interpreted in an easily digestible and intuitive way without the need for specialist skills or knowledge. In part, this is

because the systems are point-and-click in nature and require no knowledge of how to produce interactive, dynamic graphics, maps or analytics. There are three issues here – navigation of site, use of tools, and data, analytics and visualization literacy.

For a city-at-a-glance dashboard navigation is straightforward. However, for an analytical dashboard that contains a number of modules navigation around the site and finding pertinent data and analysis can be more tricky. The Dublin Dashboard, for example, had 56 sub-modules at the time of writing, some that utilize hundreds of data variables (e.g. census mapping modules). At present, there is no detailed site map or data directory. There is also no deep sense of navigation, search and browse issues as there has been no detailed user-testing. In terms of the tools presented, the Dublin Dashboard utilizes a number of different software data visualization and mapping programmes. It is sometimes not at all clear how to display data, change to new data layers, perform analysis, interact with data, etc. Nor are there any user guides to explain how to undertake different tasks. Again, there has been no user requirement or user testing analysis. This is not uncommon for city dashboards or open data sites. What this means is that city dashboards provide a sub-optimal experience for non-specialist users and their full utility is not being realized by most citizens and decision-makers alike.

Dashboards assume that their users understand what data are being presented (and to take into account issues of formulation, error/bias, etc.), can make sense of and validly interpret various forms of visualization and maps, and understand any analytics being undertaken. This, however, is not the case, and data, analytic and visualization literacy are highly variable across the general public, but also specialist users such as planners and policymakers. This is especially the case for analytics such as modelling where it is not clear how the model is calculated or what the output means. For example, in the case of Boston's City Score, the user is presented with a table of numbers, updated daily, that denote how well the city is performing in relation to a number of tasks (Figure 9.3; [www.boston.gov/cityscore](http://www.boston.gov/cityscore)). In the accompanying text the viewer is told that a number above 1 means a target is being exceeded, whereas below 1 the service is deficient and will be reviewed. However, there is no detailed information on what the tasks being monitored are, with several unexplained acronyms, and no information on the form and veracity of underlying data or how the scores are calculated and targets are set. It is therefore quite difficult to interpret the information presented.

### **Uses and utility**

What are the uses and utility of city dashboards? City dashboards are used in three main ways: for monitoring performance and managing urban services; for contextually understanding and formulating policy; and for creating public knowledge and producing counter-narratives. In addition, they can be used tactically (e.g. for delaying a strategy, substitute for action, deflect criticism), symbolically (e.g. to provide reassurance or place promotion), politically (e.g. ammunition to support a particular position) (Hezri 2004), and if the data within them are open they can help facilitate and promote an open data economy and produce transparency and accountability.

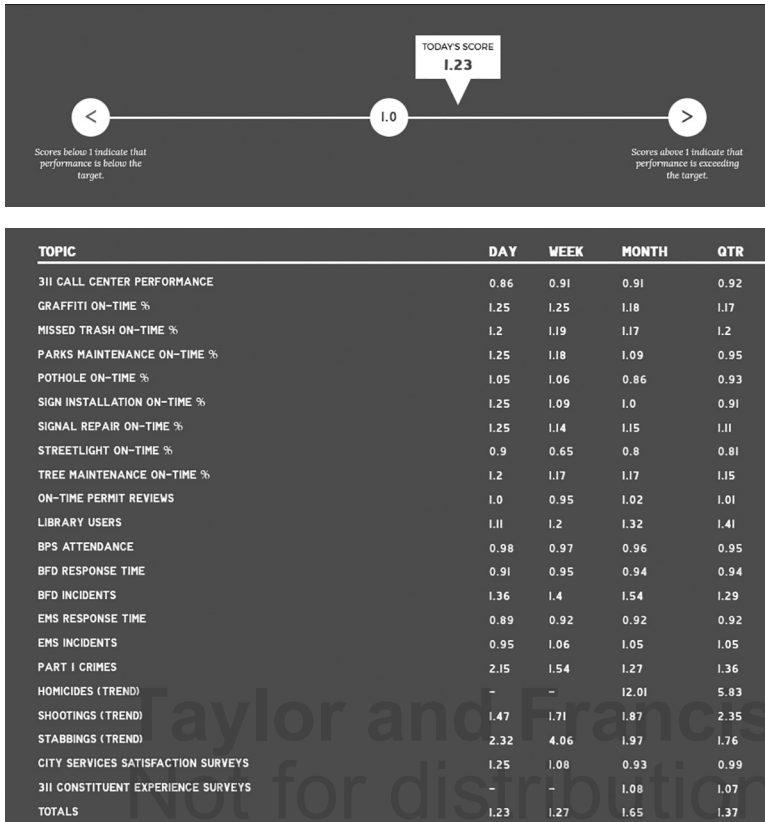


Figure 9.3 Boston City score

The realist epistemology that underpins the logic and workings of city dashboards promotes an instrumental rationality in which cities can be steered and managed through a set of data levers and analytics and that urban issues can be solved through a range of technical solutions (Mattern 2013; Kitchin *et al.* 2015). Here, city dashboards are used to: monitor and guide operational and policy practices with respect to specified targets; provide evidence of the success or failure of programmes and policies; discipline and reward performance; guide the development of new strategies; and shape spending patterns (Craglia *et al.* 2004; Behn 2014). An example of such an approach is Baltimore’s use of CitiStat. Every week the mayor and city managers meet in a specially designed room using dashboards to review performance and set new targets for the city as a whole and for each department (Gullino 2009). This approach has been adopted in whole or part by a number of other US cities. For critics, this instrumental rationality promotes a technocratic form of governance that: forecloses other modes of governance and other forms of knowledge (such as phronesis – knowledge derived from practice

and deliberation; and metis – knowledge based on experience) (Parsons 2004); fails to recognize that cities are complex, multifaceted, contingent, relational systems, full of contestation and wicked problems that are not easily captured or steered (Kitchin *et al.* 2015); and that urban issues are often best solved through political/social, public policy and public investment solutions and citizen-centred deliberative democracy rather than technical fixes (Kitchin 2014b).

In contrast, some municipalities use dashboards in a more contextual way. Here, it is recognized that cities are not mechanical systems that can be disassembled into its component parts and fixed, or steered and controlled through data levers. Instead, systems and governance are understood as complex and multi-level in nature, and the effects of policy measures are diverse and multifaceted, and neither is easily reducible to targets and performance metrics (Van Assche *et al.* 2010). Indicators highlight trends and potential issues, but do not show their causes or prescribe answers. Conceived in this way city dashboards provide useful contextual data – that can be used in conjunction with other data and initiatives – but are not used in a strongly instrumentalist, mechanistic way to direct management practices (Kitchin *et al.* 2015). A longstanding example of such an approach is that employed within Flanders, Belgium, where since the late 1990s a number of cities have employed a common City Monitor for Sustainable Urban Development, consisting of nearly 200 indicators, to provide contextual evidence for policymaking (Van Assche *et al.* 2010). The Dublin Dashboard follows this model. Nonetheless, in both managerial and contextual uses of dashboards, they are viewed as providing a stronger evidential base for city management than anecdote and occasional studies.

In cases where a city dashboard is publicly accessible it is hoped that it provides the same kinds of utility as open data in general – that is, it enables transparency, accountability and participation by providing the public with the data and the tools to extract insight and value from these data (Kitchin 2014a). In other words, it allows citizens to evaluate the work of city agencies in providing services and managing and governing the city, and it allows them to take an active role in contributing to evidence-informed debate and policymaking and to produce counter-narratives to those produced by authorities and other vested interest groups. Here, open city dashboards work to democratize the ability to produce information and knowledge, rather than the power of data being confined to its producers and those in a position to pay for data and tools.

## Ethics

How can we ensure that dashboards are used ethically? There has been a lot of concern with respect to the generation and use of personally identifiable information (PII) in the big data age, including those generated by smart city technologies (Kitchin 2016). However, city dashboards display aggregate and anonymous data or data that concerns a system rather than people. As such, ethical issues related to PII, such as individual level privacy and predictive privacy harms, are generally not pertinent. That is not to say that there are no ethical issues arising from city dashboards.

The data within city dashboards can be used to construct place profiles and histories that can be used as the basis for the social and spatial sorting of places and communities. Indeed, there is a multi-billion-dollar geodemographics industry that does precisely this, using place profiles to geo-target advertising/marketing and private investment and to calculate insurance premiums and online prices (Harris *et al.* 2005). Similarly, place profiles can be used by the public sector to determine which areas should receive place-targeted investment, additional policing or differential service provision. The data can also be used to discriminate areas of blight and problems and to reinforce territorial stigma, effecting public perception and affecting local community cohesion. In other words, the data and tools in dashboards can be used to treat places and the populations within them differentially in ways that can be discriminatory and affect quality of life. It is therefore important to consider the ways in which city dashboards are used and to consider whether their use is fair, equitable or prejudiced and how any issues might be addressed.

## Conclusion

In this chapter we have sought to document a number of key issues and questions with respect to the production and use of city dashboards. While we have provided a critical assessment that challenges some of the dominant thinking with respect to city dashboards, urban informatics and visual analytics, we also believe that dashboards provide useful insights and have much utility. Indeed, we have invested much time and effort into building the Dublin Dashboard and working with Dublin's open data portal, Dublinked, and other data providers, and we are about to build a dashboard for the City of Cork.

What is required, we believe, for city dashboards to reach their full potential as a smart city technology that can help produce more efficient, equitable, sustainable and resilient cities is a number of related shifts in thinking and praxes. First, there has to be a shift in the underlying epistemology of city dashboards to recognize that they conceive the urban in a particular way and seek to understand and explain the city using an approach which produces delineated and situated knowledge rather than communicating objective, scientific truths. Second, limitations with respect to the scope of data and accessing data sets need to be documented and also tackled by working with agencies and companies to open key data sets. Third, significant work needs to be undertaken to establish the veracity and validity of data sets and analytics and dashboards need to be populated with appropriate metadata and supporting documentation. Fourth, the usability of city dashboards in general and each specific tool needs to be established through user testing, as well as methods to improve user experience, and training and education tools to aid and improve data/analytics literacy need to be developed and included in dashboards. Fifth, the instrumental rationality of city dashboards needs to be reconceived, with dashboards always used in conjunction with other forms of knowledge and other modes of governance when evaluating, managing and formulating the delivery city services and policy. Sixth, the factors shaping the development of dashboards such as licensing, standards, institutional

practices, local politics, choices about what data to include need to be acknowledged and citizens need to be consulted about their configuration and deployment. And lastly, the ethics and potential harmful uses of using city dashboards need to be further examined and strategies need to be developed to minimize harm.

While this list is by no means comprehensive it provides an initial agenda for addressing the issues we have discussed. This shift in thinking will allow urban dashboards to reach their full potential and align them with the vision of the Open Knowledge Foundation (n.d.) who state that: ‘Open knowledge is what open data becomes when it’s *useful, usable and used* – not just that some data is open and can be freely used, but that it is useful – accessible, understandable, meaningful, and able to help someone solve a real problem.’ Moreover, this agenda will provide useful insights for considering the wider relationship between data and the city.

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