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Smart cities and urban data platforms: Designing interfaces for smart governance

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ABSTRACT

The proliferation of smart city policies worldwide in recent years has seen digital infrastructure, urban data and software design play increasingly central roles in the contemporary governance of the city. This article addresses the role of urban data platforms in supporting the delivery of smart city initiatives by city governments, with a view to establishing a typology for effective strategic investments in urban data interfaces aligned to governance objectives. Drawing on a range of different interfaces and approaches, the article discusses the proliferation of urban data platforms through a set of distinct functions and typologies. The discussion aims to position urban data platforms as key sites for the development of new governance models for smart cities, and forums in which decision-makers, researchers, urbanists and technologists seek to test the potentials and pitfalls of data-driven methodologies in addressing a range of contemporary urban challenges.

1. Introduction

Today's cities are the engines of the new data economy. The rise of new digital services such as on-demand transport, intelligent water management, responsive lighting, and distributed energy resources are rapidly replacing the legacy infrastructures and service delivery models that have served the cities of the twentieth century. As a consequence, the millions of interactions and transactions that take place in cities on any given day—from volumes of energy used, movements of people, traffic, water and waste, social media interactions, emails, financial and retail transactions and multi-modal transport flows—are now generating huge volumes of 'data exhaust'. Growing at an unprecedented rate, the data exhaust of our cities is of increasing value to governments and businesses as they seek to apply data-driven methodologies to improve the quality and efficiency of city services.

As Goldsmith and Crawford write in *The Responsive City* (2014: 3), our ability to collect, analyse and share information today has great potential to transform and even reinvigorate the governance of cities. Smart city investments are now accelerating across the globe, resulting in the proliferation of data-driven tools and platforms, designed to usher in more 'responsive' urban services capable of addressing myriad city challenges (Arup, Livable Cities, UCL, & Smart City Expo, 2014; EIU 2017). This wave of smart city investment has sparked growing skepticism across research and industry communities in the idealisation of the smart city as a vendor-oriented vision of ICT-led urban growth (Batty, 2016; Hollands, 2008; Kitchin, 2015; Luque-Ayala & Marvin, 2015; McNeill, 2015; Söderström, Paasche, & Klauser, 2014; Vanolo, 2014). However, these concerns are also accompanied by growing recognition that, whether or not cities are 'smart', the proliferation of data-driven platforms requires governments to play a much more active role in the management of their cities' data assets – the vast amounts of data generated by citizens everyday – if they are going to enlist the support of data-driven tools and services to address their city's most pressing challenges (Pettit, Lieske, & Jamal, 2017).

Indeed, it is the capacity for city governments to support and cultivate partnerships spanning public and private data custodians, citizens and software developers, that is now provoking a shift away from the concept of top-down, vendor-backed visions of smart cities (now often pilloried as 'smart cities 1.0'). In this context there is growing interest in more collaborative models of smart city governance ('smart cities 2.0') that emphasise a role for city governments in the curation and management of data assets to support a city's strategic priorities. This paper addresses emerging concepts in smart city era governance and the influence of these concepts in driving investment in new platforms or interfaces for city data. As Luque-Ayala and Marvin (2015): 8) have argued, it is important we understand how particular technologies and interfaces associated with smart city investments emerge and continue to act within wider operating conditions of the city, in helping to "more intensively unbundle and rebundle users, space, services and networks".

The paper focuses on the development of platforms or interfaces for urban data management, often called 'city dashboards' or 'datastores', as supportive services in the development of smart city governance models. It addresses a range of different urban data platforms

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developed by cities, and teases the different public and commercial agendas embedded within their design and development. Finally, it demonstrates how different platforms reveal different operational logics emerging within an environment of data-driven services and smart cities. These inform the design and development of urban data platforms and reflect the different approaches to urban data management in an era of smart cities.

1.1. From smart cities 1.0 to smart cities 2.0

The widespread uptake of smart city strategies around the world is provoking attention towards the governance challenges and opportunities of cities that are 'run on information'. According to engineering and planning firm Arup, "the smart city is so different in essence to the twentieth century city that the governance models and organisational frameworks themselves must evolve" (Arup, 2010). Importantly, the ideals of the smart city, in seeking to leverage the benefits of digital services to improve the way a city works, can't simply be realised by investing in distributed sensors and technology solutions alone, but necessitate a "'reinvention of governance' that involves transforming the way they work internally and together with outside partners and citizens" (Arup et al., 2014: 32).

For Goldsmith and Crawford (2014), increasingly abundant sources of data, from government data released in open, machine-readable formats, data created and contributed by citizens, and data contributed by private data providers, can help governments move beyond what they call the 'compliance model' in dominating the management of city services at the local or municipal level, towards more active, problem-solving capabilities "that truly value the intelligence and dedication of its employees and the imagination and spirit of its citizens" (6). The authors advocate the adoption of collaborative, data-driven models of governance that "open up the machinery of government to its people, letting them collaborate to create solutions coproduced by public servants and their constituents" (6). Data, they argue, can "deliver government whenever and however citizens need it", replacing the bureaucratic and centralised structures that have frustrated citizens and officials alike for decades (9).

Interest in the governance implications of smart city investments has become increasingly prevalent in recent years. In part, this has occurred in response to the perceived failures or lack of impact resulting from smart city investment to date. As technology consultant Rick Robinson put bluntly, "smart cities still aren't working after 20 years", pointing to the fact that despite some high-profile projects, relatively little has really been achieved (Robinson, 2016). The reason for this, Robinson writes, is in part because "the *massive* investments that are being made in smart technology at a scale that is transforming our world are primarily commercial: they are investing in technology to develop new products and services that consumers want to buy" (2016: para 16). Commercial agendas driving investment in digital tools and services may, he notes, create convenience for consumers and profit for companies, but it can't be guaranteed they will create resilient, socially mobile, vibrant and healthy cities. He writes: "Commercial agendas for smart cities are just as likely to reduce our life expectancy and social engagement by making it easier to order high-fat, high-sugar takeaway food on our smartphones to be delivered to our couches by drones whilst we immerse ourselves in multiplayer virtual reality games" (2016: para 16). It is the role of government and political leaders, he argues, to support and scale up appropriate technology solutions to address a city's greatest challenges.

While the idea that governments play an important role in addressing market failure is hardly new, the challenge here is to articulate the appropriate policy frameworks needed by governments to facilitate investment in data-driven services that are aligned to the strategic priorities of a city. Here governments have drawn from principles of the open source software movement, in which shareable, re-usable code has served as the basis for improved software products to rethink the role and design of public institutions (see Clark & Margetts, 2014; Davies & Bawa, 2012; Gurtsein 2011).

'Government as a Platform' models of digital era governance, sometimes known as 'Government 2.0′, encourage external users, whether citizens, software developers, or other businesses, to co-design government digital services. Governments, facilitating access to government data in open, machine-readable formats, can in turn encourage wider digital innovations that internal public service employees might never dream of (Barns, 2016).

This mode of digital era governance has gained traction in recent years, particularly across the UK, US and more recently Australia (see Accenture, 2016; Barns, 2016; O'Reilly, 2010; Singleton, 2015; Williamson, 2015). Accompanying the rise of 'Government as a Platform' models has been growing recognition in the value of 'public sector information' (PSI) as an important strategic asset to the wider data economy, along with customer databases and other big data sets (see Ubaldi, 2013).

As a model for public sector technology investment this approach is, likewise, not especially new. The launch of weather, communications, and positioning satellites have in the past been undertaken along similar lines, whereby governments invest in the technology infrastructure needed to facilitate massive private sector investment and subsequent innovation. A good example is the Global Positioning Satellite (GPS) service, created and maintained by the US Government, which provides geolocation and time information to any GPS receiver free of charge, and is the basis for many profitable location-based services operating in the marketplace.

'Government as a Platform' frameworks in recent years have been driven primarily by digital technology officers appointed within government. In the United Kingdom this has taken the form of the Government Digital Service, an agency tasked with 'leading the digital transformation within government' and is led by a Chief Data Officer. In the United Kingdom this approach has focused on the creation of a single or 'core' data infrastructure from which multiple software services can be built for citizens. This has removed the justification for separate IT procuring of software services by different agencies and ensured agencies have data-driven tools and services built around common functionality. It also sees concerted recruitment of data scientists and programmers internally within government, and enabling of new positions such as the 'Chief Data Officer' to lead cross-agency approaches to the use of data-driven services (see Barns, 2016, p. 559).

In the US, a newly-elected Obama Administration launched its *Open Government Directive* requiring all US government agencies to take "specific actions to implement the principles of transparency, participation, and collaboration" including the publication of government information online in open (machine-readable) formats (Orszag, 2009). Shortly afterwards, the multilateral *Open Government Partnership Declaration* (OGPD) was signed by the United States and seven other countries in September 2011.[1] The OGPD outlines four key components of what is involved in "changing the culture of government", relating to accountability, technology and innovation, citizen participation and transparency (OGPD, 2011).

These wider transitions in digital era governance provide important historical context for the investments made by city governments in urban data platforms. Epitomising a shift away from vendor-focused 'smart city 1.0′ investments towards 'smart cities 2.0' (Barns, Cosgrave, Acuto, & Mcneill, 2017), many platforms incorporate elements of the 'Gov 2.0′ or open government movement. However, they also incorporate what Goldsmith and Crawford (2014) described as the traditional 'compliance model' of local government, in seeking to measure city performance against set targets and regulatory frameworks, using more fine-grained data assets. Rather than opening up space for co-development of data services with citizens and software developers, as

[1] In 2016 the OGPD had been endorsed by 70 participating countries.

was anticipated through the 'government as platform' movement, these platforms offer more limited space for external views or data access and simply monitor performance.

In this next section 1 discuss a range of urban data platforms, with a view to understanding how their role and function reflects different approaches to the value and use of urban data by city governments, and the role of government within a city's wider data ecosystem. Rather than focusing on the visual analytics or services offered by these platforms, this discussion instead focuses what they reveal about the value and use of urban data by city governments, and in turn, the governance model pursued by the city itself in relation to the emerging 'smart cities 2.0′ agenda. This analysis is designed to clarify a distinct set of roles played by urban data platforms in the emerging urban policy landscape of smart city governance.

1.2. A city by the widgets?

The digital dashboard has become a common feature of our digital lives. Many of us probably first used the term 'dashboard' to refer to a car's control panel; in recent times, dashboards have become known as the interfaces through which we access a number of linked services. Think of Google's Dashboard, proving access to the Google applications adopted by the user, or the Wordpress Dashboard, in which a content creator can access the range of widgets and plugins needed to publish a webpage. During the era of widespread digitation of services and transactions, businesses have adopted the digital dashboard as a key performance management tool, allowing quick access to key performance indicators via data visualisations and simple metrics. Many of these characteristics of the dashboard — providing access to services and software, measuring performance, and surfacing information — have in turn informed the design of a number of urban data platforms in recent years.

Broadly speaking, these platforms share many commonalities. They are each focused on revealing data relevant to a city's operation via simple data visualisations, widgets and analytics. These provide dynamic and/or interactive graphics, maps, and 3D models to display information about the performance, structure, pattern and trends of cities (Kitchin & McArdle, 2016: 2). They are intended, like many business dashboards and car dashboards, to show critical information 'at a glance'. Fig. 1 shows examples of urban data platforms developed by city governments. They include the Boston CityScore Service, the London Datastore, the Greater Sydney Commission Dashboard, and the Dublin Dashboard, among many others. The majority of these are focused on surfacing and visualising a range of data assets relevant to a city's performance against selected indicators.

As Fig. 1 shows, there are clearly very distinct differences between these platforms. Boston's CityScore condenses performance to clearly defined indicators, while the majority present a range of data analytics via map interfaces and other visualisations. The way the platforms are designed to make data available to users also varies considerably. The Dublin Dashboard combines real-time information, time-series indicator data, and interactive maps to present different visualisations of the city, performance against indicators spanning employment, housing, environment, health and crime. The data used to create these visualisations is also available via a ‘Datastore’. As reported on the website, the Dashboard “enables users to gain detailed, up to date intelligence about the city that aids everyday decision making and fosters evidence-informed analysis”. [2] In this case, the platform is proprietary, owned and managed by Maynooth University. The UK CityDashboard, offers ‘at a glance’ views of eight cities around Great Britain, combines official, observational and social media data into a single interface. Developed by the University College London's Bartlett Centre for Advanced Spatial Analytics (CASA), the CityDashboard surfaces available data related to a city but is not itself a data hosting service.

Another UK Dashboard, the Leeds City Dashboard,[3] introduces a configurable interface for a range of ‘hyperlocal’ technologies and software tools using Leeds Open Data. The whole platform itself is 'open source', with the underlying code available via Github, meaning that anyone can replicate this mode for their own city, by adding their own data. Another well-known Dashboard, the New York Dashboard,[4] was originally established as a hosted service by open data publisher Socrata, and functions both as an open data portal and platform for the open data community to profile data visualizations and other uses of the portal. We are also seeing the use of comparative city dashboards for performance monitoring. The launch of a new ISO standard for city performance in 2014 (ISO 37120) has created a new platform for city data to be shared against a set of 100 city indicators. The 'Data for Cities' platform now allows users to compare chosen cities against their performance across environmental, economy, social equity and mobility factors (WCCD).

What are we to make of these services? The proliferation of city dashboards has attracted the attention of researchers quick to raise the spectre of a resurgent positivism and abstraction of urban knowledge. Kitchin and McArdle (2016), for example, have noted the way city dashboards tend to embody an ontology which “defines what the city is and isn't, by choosing how to represent its parts”. To Mattern (2013), city dashboards are complicit in the ‘data-fication’ of the city, of turning the city into a computational problem, based on “the presumption that all meaningful flows and activity can be sensed and measured, is taking us toward a future in which the people shaping our cities and their policies rarely have the opportunity to consider the nature of our stickiest urban problems and the kind of questions they raise.” Mattern asks: “Is there an ethos, a value system, driving these data-generated processes, or is it all just algorithms?”

These questions address the underlying epistemologies of dashboard designs, as they relate to wider understandings of the urban. However, less attention has been placed on their relative contribution to models of digital era governance, which is the focus of this discussion. As the discussion below shows, the current diversity of urban data platforms reflects a diversity of approaches to the smart governance agenda, and in turn reveals how particular city governments are operating within the wider data economies of their cities.

1.3. Governance typologies embedded within urban data platforms

This section explores the relative positioning of a range of urban data platforms to the wider 'government as a platform' agenda. As discussed, this agenda emphasises the role of government in curating and facilitating wider access to government's open data, and encourages external users, whether citizens, software developers, or other businesses, to co-design government digital services. The agenda is of growing importance to the smart cities movement in establishing a role for government in curating and facilitating access to a range of public and private data associated with proliferating digital platforms. Thus, while many dashboards are presented by their city governments as part of wider digital and/or smart city strategies, there are in fact a number of distinct positions adopted. These distinctions are discussed in more detail below.

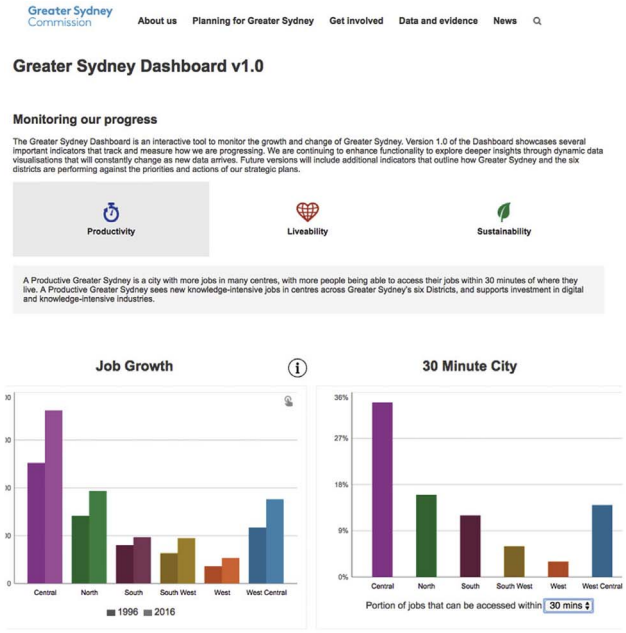
1.4. Data showcases: dashboards

Urban data platforms informed by a clear open data strategy are designed to make underlying data available to their uses focus on making underlying data assets available as part of a wider ‘ecosystem’ of data assets (Pettit et al., 2017). While these began as open data

[2] http://www.dublindashboard.ie/.

[3] http://dashboard.leedsdatamill.org/.

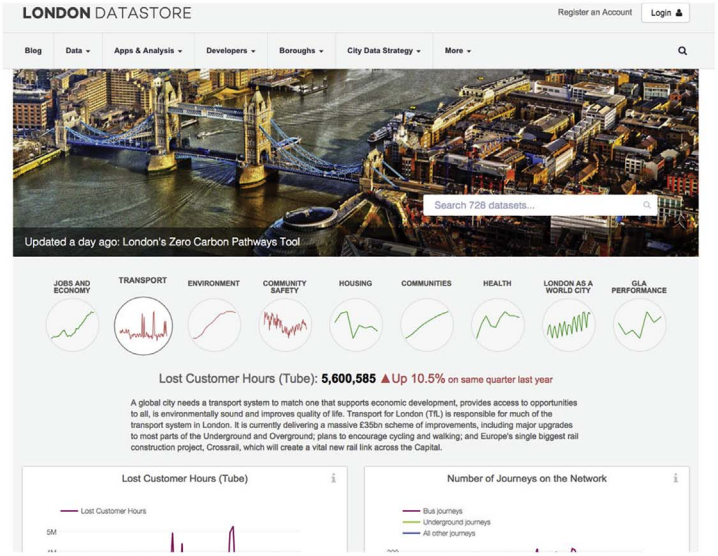
[4] https://nycopendata.socrata.com/.



1. Greater Sydney Commission Dashboard v1.0 http://greater.sydney/dashbboard

2. Dublin Dashboard http://dublindashboard.ie

3. Boston CityScore http://boston.gov/cityscore



4. Greater London Authority Datastore http://data.london.gov.uk

Fig. 1. Four examples of Urban Data Dashboards.

listings with relatively limited alignment to current policy priorities, in more recent times, these platforms have evolved. External or co-innovation initiatives by universities have led to independent dashboard services not run by the city government itself, but rather by external researchers or data specialists.

These tend to function as ‘data showcases’, and can feature a wide array of data visualisations from public or private service providers intended for wide audiences. Many simply offer a quick, ‘at a glance’ window into what is happening in a city in real-time. These integrate live data feeds from official, observational and social media data into a single interface.

The University College London's (UCL's) ‘CityDashboard’ service, for example, delivers data snapshots of eight cities around Great Britain. The service has recently been replicated in Sydney (Pettit et al., 2017). As platforms run outside of government, the focus with these services is less to do with benchmarking performance: they more focused on making use of available data to provide ‘windows’ into understanding the city. Delivered through map or grid views, datasets can span weather observations, transport services releasing live feeds such as tube line running or bike sharing facilities, and other live data from air quality to Twitter trends to local news updates. Another example of this 'value-added' approach to open data services is the NYU UrbanProfiler, developed in prototype by the Centre for Urban Science and Progress. The UrbanProfiler works with 300 datasets released through the New York City's open data catalogue and allows users to query a range of urban data by asking queries over attributes, content, and to filter datasets based on a given time period or a region (Ribeiro, Vo, Freire, & Silva, 2015). The intention is much less to visualise the data as to make more relevant search querying possible, in the context of large volumes of open data available about a city.

1.5. Data services: datastores and marketplaces

More recently, the release of government data in open data formats has led to greater investments in ‘data marketplaces’ or ‘datastores’. These are distinct from 'Data Showcases' in that they prioritise access to government data as an asset or input into wider services innovation. A recent example is the London Datastore, established by the Greater London Authority (see below). Data Services Dashboards are, on balance, less focused on performance management or real-time data and instead provide access to raw data sources in open publishing formats as the basis for deeper external engagement. These services are deliberately aligned with the 'Government as a Platform' digital strategy, and deliver machine-readable data or APIs. They tend to be built using an open source framework such as the CKAN platform, or use a proprietary cloud hosting service such as Socrata.

The City Data Exchange, established within the City of Copenhagen, has extended the model of the urban data platform-*as*-a-service. The role of the platform is to provide a service for the sale, purchase and sharing of a wide variety of data from multiple sources between all types of users in a city – citizens, city government, businesses.[5] This is not run solely by the city government itself, but by tech firm Hitachi. Its key audiences are large established companies, small medium enterprises, start-up companies, as well as academia and public sector. While the marketplace encourages users to focus on integrating multiple sources of information to meet the challenges of sustainability and quality of life, there is limited performance monitoring captured in the marketplace itself. The function is much more closely aligned to surfacing the (usable) data assets of the city, via the number of data sets 'traded' in the marketplace, rather than visualising the data per se.

1.6. Score cards: CityScore

A number of urban data platforms are much more geared towards monitoring progress or performance against agreed indicators. Created by city governments, often within a wider strategy of data-driven services, these platforms are focused on improving the granularity and responsiveness of government reporting, rather than the accessibility of underlying data itself. They serve to monitor performance against targets, not facilitate wider access to city data or data-driven services. A recent example is the Greater Sydney Commission Dashboard,[6] which addresses a range of targets and goals relevant to a 20-year metropolitan planning strategy, and provides data visualisations to communicate how it is progressing against these goals. While underlying data is accessible via explanatory text about the analytics, the primary purpose of this dashboard is to communicate progress against explicit goals.

These different features of urban data platforms are summarised below in Fig. 2.

1.7. From data marketplaces to data-driven performance management

The following discussion focuses in more detail on two specific urban data platforms that have developed in recent years. As I discuss below, the London Datastore's development over the past six years has been explicitly focused on building collaboration and 'openness' not only by releasing data out into the public, but also by involving key stakeholders early in the project's development. The Datastore is also explicit about the necessary internal investments needed to achieve the data analytics accessible online, including an expansion of internal research resources to include maths and hacking skills, and investment in internal data sharing partnerships between London Boroughs (GLA 2016). On the other hand, the Boston CityScore example is focused on demonstrating the city's capacity to perform against agreed objectives, and uses as close to real-time data to provide its daily 'scorecard'. Operating within a wider ecosystem of data services, including open data channels, the focus for data innovation is in the speed and granularity with which it can report on city performance. These two examples are discussed as illustrating the different governance agendas embedded within urban data platforms.

1.8. CityScore

In January 2016, the Mayor of Boston launched 'CityScore'[7] a new tool that uses data to grade how well the city is performing, on everything from fire department response time to school attendance to fixing potholes. The score today, as I write this piece, is ‘1.12’. This number represents an aggregate of key performance metrics about Boston, spanning response times to 311 calls, tree maintenance, crime statistics, library users and some 18 other chosen metrics. A number above ‘1’ means performance is above target; below 1 and the city is not meeting its target.

When the initiative was first launched, Mayor Marty Walsh said in a statement: “This overview of city metrics allows us to take immediate action within our departments to improve city services to make our city safer and smarter” (Walsh, in Enwemeka 2016). In the lead up to the launch of CityScore during 2015, the city reported that simply being able to see the data every day in CityScore allowed them to identify issues with performance very quickly. A backlog of sign installations, for example, was quickly addressed. As reported on the CityScore website: “[I]nstallation increased 21% in just 6 months!”.

Boston's CityScore represents the extension of many existing data-driven dashboards managed by city governments, in that it aggregates multiple data-sets, as close to ‘real-time’ as possible, to create an overarching performance indicator. It is supported by an open data portal that promotes public access to the data that informs the indicator, but also uses that data to promote internal efficiencies and improved performance within the City of Boston. Its creation builds on extensive investment in city analytics by the City, and a public commitment from the Mayor of Boston to use data analytics to improve the way the city operates. Investment in internal data analytics capability has resulted in an ecosystem of data platforms, including an 'Open Checkbook' platform where the public can view all the city's expenditures and the vendors they are working with.[8]

Boston's CityScore platform highlights the dependencies between particular city dashboard designs, and broader city-wide policies of digital governance. CityScore doesn't exist on its own as a standalone digital platform, it is part of a wider data ecosystem that has been established by a range of city actors over the past five years. As a service, it serves a set of particular functions within this wider ecosystem, and complements existing investments within the Boston area.

1.9. The London Datastore

The London Datastore[9] supports data accessibility within a framework of metropolitan strategic planning goals. Established by the Greater London Authority in 2010, the London Datastore is a free and open data-sharing portal where anyone can access data relating to the city – much like the data service model. However, there is a data curation strategy underpinning this that is focused on building a more integrated picture of available government data to support the work of the GLA.

Prior to its establishment, London's 33 boroughs would generate

[5] https://www.citydataexchange.com.

[6] http://greater.sydney/dashboard.

[7] See CityScore at https://www.boston.gov/cityscore.

[8] http://www.betaboston.com/news/2014/07/09/with-open-budget-mayor-walsh-opens-up-more-city-of-boston-data-makes-it-easier/.

[9] See https://data.london.gov.uk/.

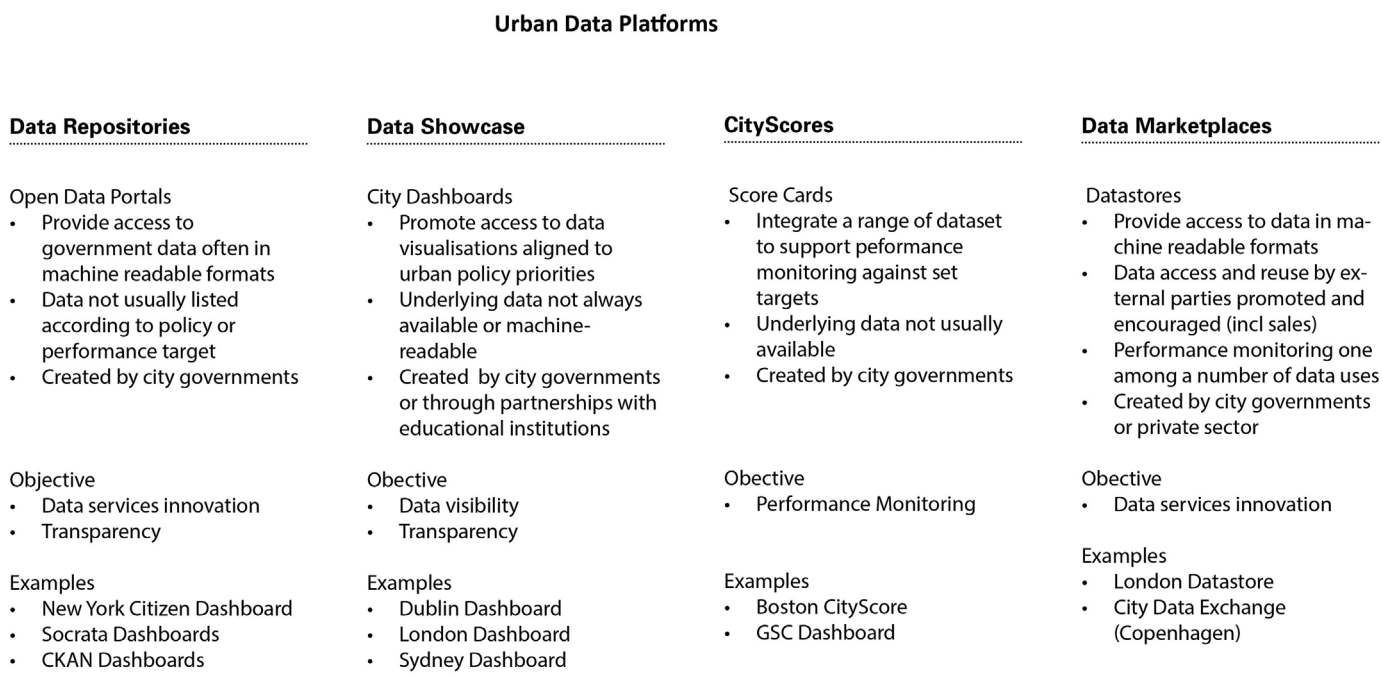


Fig. 2. Urban Data Platforms: Key features.

their own data but share little of it with each other (NESTA, 2015, p. 25). The Datastore set out to address this problem. Launched initially to provide access to open data sourced from across the Boroughs of the Greater London metropolitan area, the datastore began its life with 50 datasets, increasing these 200 over the next four weeks (Coleman, 2013). By 2016 the Datastore hosted some 684 datasets, along with a set of indicators across jobs and economy, transport, environment, community safety, housing, communities, health and the performance of the GLA itself. Comparative to many open data dashboards, the London Datastore reports data-driven analytics according to their alignment to wider strategic planning and governance challenges for City Hall. It also features relevant social media posts and news and strategy relating to the development of city analytics and open data by the GLA. In this regard, it serves both to make data more functionally available to citizens, software developers and industry, but to also focus a conversation around open data and its potentials or limitations for the work of City Hall and its ability to achieve key strategic objectives. Its range of features also reflects a growing investment in data science capabilities within the GLA, including the expansion of the Intelligence Unit from traditional demographic and related domain expertise to including hacking and coding skills (Lapsley 2016).

As outlined in a March 2016 City Data Strategy called *Data for London*: "The city needs to be planned and built with data, and future data exploitation, in mind." (GLA, 2016) The strategy continues: "We want London to have the most dynamic and productive city data market in the world. […] City Data will be recognized as part of the capital's infrastructure." This positions the role of the Datastore not only as a set of 'glanceable' visual analytics but as a marketplace for the facilitation and use of government data by the wider data services economy (MIT 2016). A London Borough Data Partnership is run to support the work of London boroughs in sharing, organizing and structuring data in more consistent formats, to enable development of analytical tools, big data approaches and new collaborations to deliver social, economic and environmental improvement in London's communities (GLA n.d.).

The development of the London Datastore is explicitly aligned with the 'Government as a Platform' agenda widely implemented in the UK at a national level by the Government Digital Service (see (Mayo & Steinberg, 2007, p. 456). Emir Coleman, the GLA policy officer who drove its original establishment, wrote in *Lessons from the London Datastore* that from 2007 her work within City Hall became heavily influenced by the rise of the open data movement and specifically that of the Open Government Working Group, lead by Tim O'Reilly and Claire Malamud. In moving to establish an open data portal, Coleman was keen to ensure that policies and practices around open data within the Greater London Authority be developed as a 'two way process' between the developer community and City Hall. During early consultations, she was advised by developers to "'go ugly early' and not make the mistake that government often does of allowing perfection to be the enemy of good". This meant that releasing data in anything other than PDF format, with developers happy to 'clean up the data' make it more usable on behalf of the state (see Coleman, 2013).

Coleman's development approach departed from her previous work in communications, engagement, policy and strategy which, she says, "were spent trying to articulate difficult propositions to an often apathetic or hostile electorate". Bringing external stakeholders into the program development process at an early stage was, she reflects, "very powerful". She says:

> I believe that it is something government needs a lot more of if it is to have any hope of repairing the democratic deficit that exists around the world. Open is the only way to achieve this" (Coleman, 2013).

Coleman's reflections reinforce the analysis by Dunleavy and Margetts (2015) that despite a decade of widespread internet use, the online worlds of governments and citizens have remained "surprisingly separate" with governments "failing to capitalise on the affordances of big data and citizens unable to interact with government digitally to anything like the extent they do with firms or social enterprises." (Dunleavy & Margetts, 2015, p. 5). The work of the London Datastore should, at least partially, be recognized as a new governance context through software developers and city officials seek to test the potential values of civic data within and beyond City Hall. As Coleman reflects, this was always a difficult negotiation with city officials ambivalent about the risks of making government data available for uses other than its original intention. Today, the rise of the 'data economy' and recognition of the value of open data not only to support more collaborative governance, but also contribute to 'big data value chains" remains core to City Hall's ongoing investment in the program.

1.10. Urban data platforms: form follows function?

As this discussion has shown, urban data platforms have multiplied in recent years, as city governments and researchers explore novel approaches to the visualization and use of city data in multiple formats. Their development has taken place against a backdrop of emerging governance challenges and opportunities emerging in response to the rise of data-driven services, including the open government agenda with its notion of 'government as a platform', the rise of smart cities which emphasise data-driven approaches to addressing city challenges, and the increasing emphasise on real time, data-driven performance metrics. These different agendas reflect a range of emerging positions city governments are taking to the release and management of their data.

As discussed, criticism of smart city investments to date has given rise to a 'smart city 2.0′ movement that emphasises the need for governments to invest in tools and services that support wider access to a range of data assets across government open data, citizen data and private data. Likewise, the government as a platform agenda seeks to encourage government agencies to invest in the collaborative development of digital services in partnership with citizens, software developers, researchers and others.

These governance contexts for urban data platforms are, ultimately, critical in shaping their broader remit. Much analysis of city dashboards has, to date, largely been conducted in representational terms, whereby it is the nature and scope of dashboards' visual or analytical representations of urban settings that is at stake, resulting in an emerging body of critical academic literature devoted to the field (Kitchin and McArdle, 2016, Kitchin et al., 2015; Mattern, 2013; 2016; Tkacz and Bartlett, 2014). The epistemologies of dashboards are, along these lines, criticised for cultivating a "top down, technocratic vision" of their cities (Mattern, 2016). This is can be problematic when "matters such as the active engagement of all the stakeholders involved in designing, operating, and controlling these dashboards are not properly addressed." Such criticism reflects a failure of many city dashboards to clearly articulate their functional scope, as they may pertain to stakeholder engagement, performance management, open government, open data and strategic planning.

Ultimately, the design and implementation of a city dashboard will reflect which of these functions are most important to the project owner. For example, a city dashboard developed as a community engagement tool, but simply publishes an open data catalogue without facilitating online and offline engagement forums with targeted stakeholders, may be seen as ineffective and lack internal traction or 'buy in'. A dashboard developed as a reporting tool by government that fails to publish underlying data assets on may be subjected to criticism by technologists and developers. Similarly, a city dashboard that curates available public and private real-time feeds may be limited in its capacity to engagement with stakeholders beyond the technology community.

A clearer typology of urban data platforms provides an important way to better clarify the range of data governance agendas embedded within these investments. Data snapshots, data showcases and data marketplaces each embed within them different opportunities for city governments to play an active role in the management of their city's data assets. As the discussion has shown, there are different models of data-driven engagement adopted across each. The data marketplace promotes access to data as an input or service to other digital tools or software, and is closely aligned to the notion of government 'as a platform'. The ScoreCard model uses a range of granular data to support performance monitoring against internal targets or goals, but tends not to encourage more collaborative models of engagement within its design and scope. The Data Showcase reflects the more collaborative relationships between external stakeholders (universities in particular) made possible through the more widespread release of government open data to external users.

The typology outlined in this discussion is intended to provide a clearer framework through which to evaluate the longer term impact of urban data platforms. Ultimately, urban data platforms should aim to support the role of city governments in cultivating partnerships spanning public and private data custodians, citizens and software developers. This approach can better support more collaborative models of smart city governance ('smart cities 2.0′) in which governments provide the data infrastructure to support improved curation and management of data assets to support a city's strategic priorities. These initiatives can, in turn, be used to support the more effective monitoring of a city's performance over time (city scorecards), by facilitating a more collaborative approach to data curation and visualization.

2. Conclusion

This paper has discussed the development of platforms or interfaces for urban data management, often called 'city dashboards' or 'datastores', as supportive infrastructure in the development of smart city governance models. It has addressed a range of different urban data platforms developed by city governments, introducing a typology of urban data platforms that span data snapshots, datastores and scorecards. This typology aims to clarify how different platforms reveal different functional logics of urban data platforms. The discussion has aimed to show that like an iceberg, perhaps slowly melting, that which is visualised and revealed by urban data platforms may not, in fact, the whole story. Underpinning their interfaces and perceived 'top down visions' (e.g. maps) are a range of socio-technical engagements, collaborative forums, and technical and governance challenges, being negotiated daily by a range of actors both within and outside city administrations. It is hoped that by engaging with a broader set of policy challenges and settings to which city dashboards respond, this discussion has helped to clarify their role as important domain for urban policy and practice in a world of data-driven services and smart cities.

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