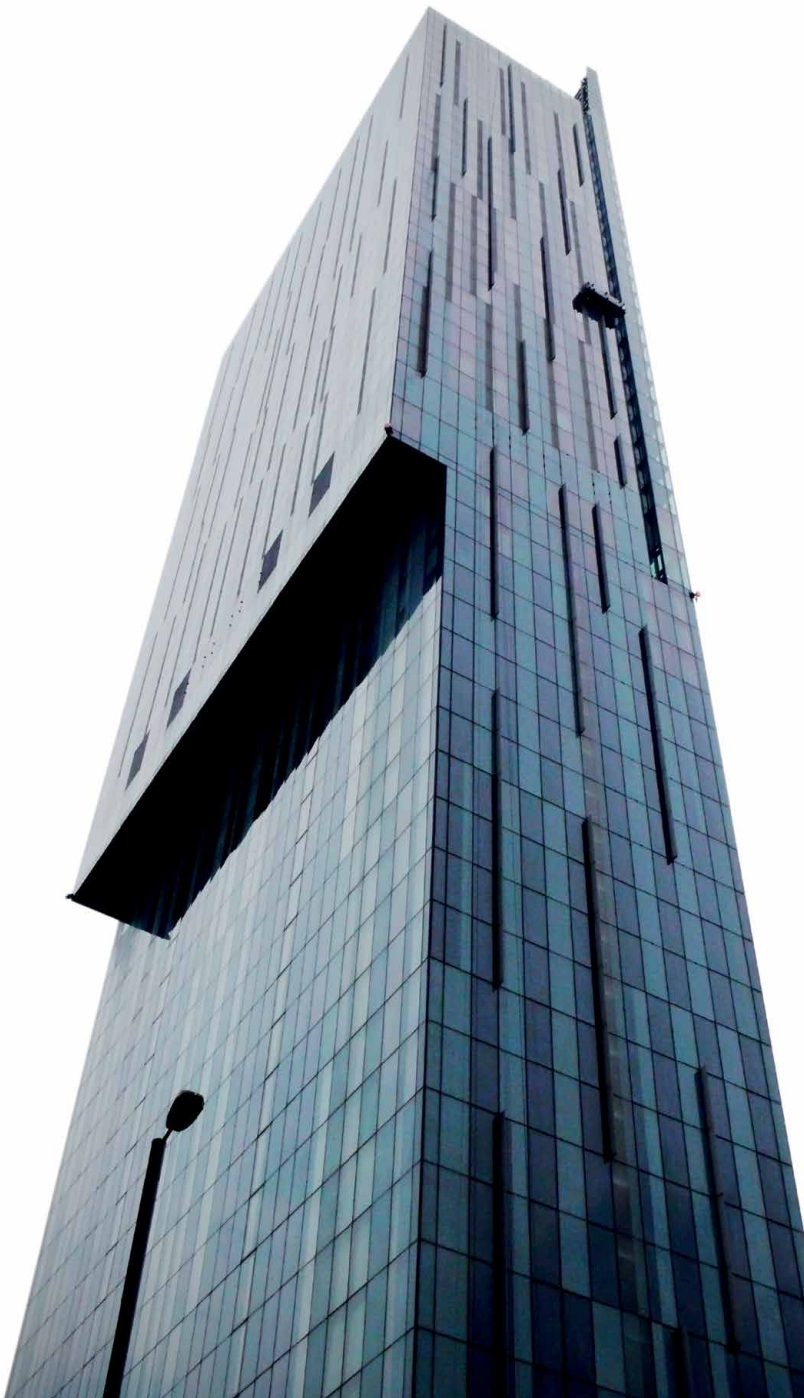
Smart Devolution

Why smarter use of technology and data are vital to the success of city devolution

Cameron Scott and Eddie Copeland



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Executive Summary

Two key policy programmes lie at the heart of the Government's work to make the UK's cities better, more vibrant and sustainable places to live, work and visit.

> *The first is city devolution; the second is smart cities.*[1]

Each has the potential to bring many benefits to the UK's urban areas. Each faces significant policy barriers to achieving its aims. The central argument of this report is that a successful city strategy requires both to work together; each provides what the other needs. City devolution equips mayors with extensive new powers. But those powers will fail to have impact without the tools to use them effectively; *tools which smart cities can provide*. Smart cities, meanwhile, offer a suite of remarkable technologies that can improve cities. But those technologies will deliver little without the right people, powers, resources and skills; *things that city devolution can put in place*.

Understanding how the two programmes complement each other requires appreciating their mutual dependency on data.

Why city devolution needs smart cities

City devolution will give a new generation of elected mayors powers and budgets to boost regional economic growth and to deliver more efficient and effective public services. But how will they determine where best to direct their resources?

The answer is by using data. Mayors will require data to identify the scale and location of the problems they seek to tackle and the service demand they aim to meet. So, too, will they need data to execute their powers effectively. Many of the big opportunities for increasing the efficiency and effectiveness of public services – joining up services across local authority boundaries, intelligently coordinating activity between different public sector partners, predicting and preventing problems from occurring – require making smarter use of data.[2] Finally, mayors will require data to monitor – and to report back to central government – the results achieved with their devolved powers.

It is therefore highly problematic that most UK cities have failed to put in place even the most basic mechanisms to join up, analyse and act upon the vast quantity of data they already have. All too often, public sector data remains locked away in organisational silos, its value untapped. Like a jigsaw that has never been put together, cities have all the pieces, but no way of seeing the bigger picture. Left unresolved, mayors will be leading blind.

Smart city techniques and methods offer a solution.

Specifically, UK cities can learn from the Mayor's Office of Data Analytics (MODA): the data-driven smart city model pioneered under Mayor Michael Bloomberg in New York. MODA is a small team based in City Hall that has the capabilities, technical resources, skills and leadership to combine, map, interrogate

1 City devolution is a constitutional move to hand powers, responsibilities and budgets from Whitehall to city regions in return for accepting new governance structures, including a directly elected mayor. Smart cities are urban areas that use cutting-edge technology (e.g. The Internet of Things) and data techniques (e.g. Big Data analytics) to tackle urban issues such as congestion, pollution and pressure on public services; stimulate new business growth; and strengthen communities.

2 These smarter ways of working were explored in detail in: Policy Exchange, "Small Pieces Loosely Joined: How smarter use of technology and data can deliver real reform of local government", January 2015.

and analyse data from around 40 separate city organisations across New York's five boroughs – exactly the capabilities that city devolution will require. Chapter 2 argues that, as a condition of receiving devolved powers, each city should emulate the MODA model by establishing its own Office of Data Analytics (ODA).

Next – recognising that the public sector is neither the only producer nor consumer of city data – cities should seek to deliver economic growth and public sector reform by harnessing the hugely valuable datasets held by citizens, businesses and other organisations. Chapter 3 explains how cities can do this by replacing their open data portals with a City Data Marketplace (CDM). A CDM is an online marketplace where different creators and consumers of data can buy, sell, request or freely offer data. The report highlights how this could help source data to prevent cycling accidents, improve congestion, support new business growth and optimise public transport routes.

Together, these two smart city initiatives can provide the data tools on which the success of city devolution will depend.

Why smart cities need city devolution

Technology has influenced almost every aspect of modern life, changing the way people live, work, communicate and play. It can transform cities, too, offering innovations from driverless cars to buildings that intelligently manage their own energy consumption; and from smart street lighting to bins that report when they need emptying. Yet in the UK, several obstacles hinder the development of such "smart cities"; *obstacles that city devolution can address*.

First, the UK's fragmented system of local government makes it hard to implement smart city initiatives at a whole-city scale.[3] City devolution provides a single political authority – an elected mayor – that can lead and coordinate smart programmes across the region. Second, cities struggle to invest in smart initiatives as budgets are divided between different local authorities and public sector partners. City devolution can provide city-wide pots of funding. Third, at a time of tight public sector budgets, cities struggle to find the capital to invest in smart city technologies.[4] City devolution offers new funding streams (such as the retention of future growth in business rates).[5] Fourth, smart cities do not merely need technology – they need people with the expertise to procure and implement it effectively. City devolution could provide the mechanism to put in place key technology and data leadership roles such as a Chief Technology Officer and Chief Analytics Officer. Fifth and finally, smart initiatives are frequently considered a matter of niche technical interest. City devolution gives local areas the powers to apply them to important areas such as policing, transport and housing, transforming them into a major instrument for delivering public policy.

Beyond these direct benefits, by encouraging cities to start with smart initiatives that address city devolution's *data* needs (i.e. by putting in place an ODA and a City Data Marketplace), they will also have a surer foundation on which to build more ambitious smart city initiatives. Smart cities are, after all, first and foremost *data-driven* cities. Whether they are new or retrofitted, high-tech or low-tech, top-down or bottom-up, public sector- or private sector-led, all use data to detail or quantify aspects of city life so that better decisions can be made: by government, by businesses, by charities, by citizens and increasingly – with the advance of the Internet of Things (IoT) – by machines.

3 No fewer than 26 of the UK's largest towns and cities fall under the remit of more than one local authority.

4 See, for example, the Smart City Forum's briefing paper on financing and proving business cases. Available at: https://futurecities.catapult.org.uk/project-full-view/-/asset_publisher/oDS9tiXrD0wi/content/project-smart-cities-forum/?redirect=%2Fproject

5 HM Treasury, "Chancellor unveils 'devolution revolution'", 15 October 2015, available at: https://www.gov.uk/government/news/chancellor-unveils-devolution-revolution

Having developed the ability to use their existing data, cities will be better able to handle the exponentially greater amounts of data that Internet of Things-based smart city technologies will provide. Having identified the gaps in their existing data, cities will also have a clearer business case for investing in new technology that fills them. And by stimulating demand for data with their City Data Marketplace, cities can create an incentive for businesses to take on the financial risk of investing in smart city infrastructure, since companies can charge for the data their technologies provide, rather than for the infrastructure itself. These points are explored in detail in Chapter 4.

There are, of course, numerous aspects of smart city development that do not depend on government, and are therefore unaffected by city devolution. Regardless of any public sector intervention, companies from small start-ups to tech giants will still innovate to develop new smart city technologies and sell them directly to businesses and consumers. Citizens, charities and voluntary groups will continue to use technology of their own accord to collaborate on community-based projects that matter to them. But for the many areas where government plays the role of driver or enabler, city devolution will help smart projects deliver on their full potential.

Better together

Treated in isolation, city devolution and smart cities will be a poor shadow of what they could be. However, by linking the two programmes together – and recognising that both require mastering the use of data – the challenges listed above can be addressed, enabling the Government's aspiration for regional economic growth and local public sector reform to be realised. Policymakers must therefore look to equip the UK's cities with both brains *and* brawn. Powers and the tools to use them. Smart devolution.

Summary of recommendations

Chapter 1

Coordinating government policy in support of the UK's cities

Recommendation 1: The Government should recognise the mutual dependency between city devolution and smart cities and ensure its policies towards both are coordinated. A key part of the negotiations with the 15 cities that applied for devolved powers as part of the Spending Review 2015 process should be requiring cities to outline how they will use smart measures to ensure they meet the goals of boosting regional economic growth and improving local public services.

Chapter 2

Using existing public sector datasets to effectively deliver devolved powers

Recommendation 2: As a pre-condition of receiving devolved powers, cities/city regions should be required (and supported by central government) to establish an Office of Data Analytics (ODA), led by a Chief Analytics Officer, reporting directly to the mayor. Each ODA should be tasked with helping the mayor and the city region's public sector bodies to harness analysed data to: 1) identify the scale and location of the problems they seek to tackle and the demand they aim to meet; 2) execute their powers effectively to enable regional

economic growth and local public sector reform and; 3) measure the impact of devolved initiatives so policies can be refined and scaled. Matched funding for ODAs should be provided by central government departments.

Measuring and reporting on the use of devolved powers

Recommendation 3: The Government should require ODAs to provide data on how newly devolved powers are delivering against city devolution's objectives. This data should be published nationally in an annual report to encourage best practice to be shared between cities.

Opening central government datasets to aid city devolution

Recommendation 4: Central government should establish a dedicated team responsible for "data devolution". Cities and city regions should be able to request access to datasets held by central government that support them in managing their devolved powers.

Chapter 3

Encouraging external developers to make products with open data

Recommendation 5: Each city's Office of Data Analytics should take on responsibility for providing open data that covers the whole city. The open data ODAs provide should be a subset of the data that is used by the public sector itself. Providing open data at a city scale (rather than by each local authority) will help more developers find a viable business model, as there will be a larger potential customer base for their products and services.

Recognising the value and utility of private sector data

Recommendation 6: Cities should proactively seek to harness private sector data to deliver their policy priorities. For example, data from mobile phone networks and haulage companies could be used to improve road safety, while data from electronic payments companies could help increase economic activity, optimise public transport routes and enable better management of public services. Data should be priced according to the value of the outcomes it can enable, rather than on a per byte basis.

Ensuring an effective public/private sector market for city data

Recommendation 7: Each city ODA should create its own City Data Marketplace. Cities should replace their open data portals with a city data marketplace where different creators and consumers of city data can buy, sell, request or freely exchange data. This would help unlock, correctly price, and stimulate demand for data held by citizens, businesses and other organisations both within and outside the public sector.

Guarding citizens' data privacy and ensuring the legal and ethical use of data

Recommendation 8: Those selling or offering data on the City Data Marketplace should be required to provide evidence that they comply with the Information Commissioner's Office (ICO) Anonymisation Code of Practice. Ensuring public confidence in cities' use of data will be vital for the success of data-driven initiatives. Where public sector organisations in a city choose to use private sector data, they should share responsibility for assuring that ICO regulations have been met.

Chapter 4

Spreading data skills throughout the public sector

Recommendation 9: ODAs should collaborate with local university departments, FE colleges, the Open University, the Open Data Institute and the Digital Economy, Transport and Future Cities Catapults to source staff and to set up Data Analytics training courses to educate public sector workers – and especially public sector leaders – about how to use data. In educating organisations about how to use their own and ODAs' information in their day-to-day and strategic responsibilities, ODAs can help stimulate demand for data, ensuring the data-driven smart city model grows in scale and effectiveness.

Putting in place key data and technology leadership roles

Recommendation 10: As part of the city devolution negotiations, cities should explain how they will put in place key leadership roles such as a Chief Analytics Officer and Chief Technology Officer. The Government regards an elected mayor as necessary to deliver city devolution, but it is not sufficient. Given the vital importance of data to the success of city devolution, a Chief Analytics Officer role should be put in place to lead the city's ODA. In due course, a Chief Technology Officer role will also be needed to ensure that cities can make informed decisions about the smart city technologies they really need, ensuring they are future-proof, value for money, and that they avoid vendor lock-in.

Chapter 5

Recognising the importance of data networks

Recommendation 11: As cities consider the technology they need to enable smart initiatives to thrive, they should recognise that data networks are the vital underlying infrastructure. Cities should seek to maximise their use of existing networks (e.g. those for mobile phones and electronic payments) and work to incentivise the private sector to create new Internet of Things networks by stimulating demand for data.

1
The Rise of the City

"If we embrace reform… devolve power and maximise the use of digital technology, we won't just balance the books, we will lay the foundation for the most radical and most progressive government of our recent history."

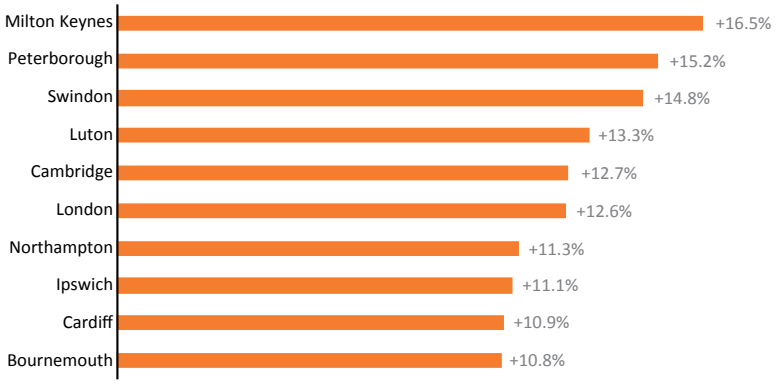
David Cameron[6]

Since 2010, cities and city regions have been at the very heart of the Government's policy agenda.[7]

It is not hard to see why. Britain has one of the highest rates of city living among the G20 countries, with fully 80% of the population residing in urban areas. Cities are the UK's economic engines, contributing 63% to national output; London alone is responsible for 22%.[8] Cities are hubs for culture, for innovation, for entrepreneurship, for jobs and productivity. They are the places where people, groups and businesses mix together; and where – to quote Matt Ridley – "ideas have sex".[9] A huge amount rides on ensuring their future success.

Cities also face some of the most significant policy challenges. Not least is how to respond to the growing demands placed on their public services, transport, infrastructure, energy and housing by expanding populations. Those challenges will only increase. In February 2015 London finally caught up to and surpassed its 1939 peak population of 8.6 million people. No fewer than 10 UK cities experienced population growth of more than 10% between 2004 and 2013. And it is projected that the UK population will reach 77 million by 2015; greater than any country in the European Union.[10]

Figure 1A: UK's 10 fastest growing cities, 2004–2013



Source: Graph from http://www.theguardian.com/cities/datablog/2015/jan/19/uk-cities-ranked-jobs-migration-house-prices-broadband-speeds-data

6 Speech, Prime Minister: "My vision for a smarter state", September 2015, available at: https://www.gov.uk/government/speeches/prime-minister-my-vision-for-a-smarter-state

7 For instance, the Government has introduced the Localism Act (2011), City Deals (2012, 2013), Growth Deals (2014) and Super Connected Cities schemes (2012).

8 ONS, "Regional Gross Value Added (Income Approach)", December 2014, available at: http://www.ons.gov.uk/ons/dcp171778_388340.pdf

9 Matt Ridley, *The Rational Optimist: How Prosperity Evolves,* 2010.

10 CityAM, "Population growth: UK to become biggest country in European Union by 2050", 28 July 2015, available at: http://www.cityam.com/221125/population-growth-uk-become-biggest-country-european-union-2050

This report focuses on the opportunities and challenges surrounding two of the most significant strands of the Government's work to make UK cities better, more vibrant and sustainable places to live, work and visit. The first is city devolution; the second is smart cities.

City devolution

In his first major speech following the 2015 General Election, the Chancellor of the Exchequer, George Osborne, stated:

> *"The old model of trying to run everything in our country from the centre of London is broken… We need fundamental change – and this is the once in a lifetime opportunity to deliver it… Today I can tell you we will go much further and deliver radical devolution to the great cities of England. I say to these cities: it is time for you to take control of your own affairs."*[11]

Given that the UK is currently one of the most centralised states in the OECD, the Chancellor's remarks represent a significant constitutional change.[12] To deliver his vision, in May 2015 the Government introduced the Cities and Local Government Devolution Bill. The bill opens negotiations between central government and local (or combined) authorities to grant cities more extensive powers and resources in return for adopting new city-wide governance structures. While the Government hopes many benefits will follow from city devolution, two major objectives stand above the rest: 1) to promote regional economic growth, and 2) to innovate to provide more efficient and effective local public services.

Greater Manchester is the first area to complete a devolution settlement. A new mayor will be elected in 2017 to represent the city region. The position will come with powers to invest in transport and housing projects, set local planning strategy, exert greater control over land development, and take charge of the city's police and fire services. The mayor will also control new funding streams by both retaining and being able to borrowing against future increases in local business rates.[13] Under the mayor's stewardship, the Greater Manchester Combined Authority (GMCA) will additionally receive devolved powers to design local skills provision, handle business and unemployment support and set a joint health and social care strategy.[14]

Where Manchester has started, others will follow. As of 4 September 2015 (a deadline set by the Chancellor), 38 proposals for devolved responsibilities were submitted by local areas for consideration by the Government.[15]

Smart cities

Meanwhile, in cities all around the world, residents and city leaders have started turning to technology and data to solve some of their most pressing urban challenges, to create new economic opportunities and to build stronger communities. Noting the success of such "smart city" initiatives from Rio de Janeiro to Barcelona and from Masdar to Chicago (see Box 1), the British Government has been interested to explore whether similar initiatives could help meet the UK's needs, too.[16] That interest has already moved far beyond mere theorising:

11 HM Treasury, "Speech: Chancellor on building a Northern Powerhouse", May 2015. Available at: https://www.gov.uk/government/speeches/chancellor-on-building-a-northern-powerhouse

12 Rt Hon Greg Clark MP, "Decentralisation: an assessment of progress", December 2012. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/16593/Decentralisation_an_assessment_of_progress.pdf

13 Through an "earn back" agreement, the Mayor of Greater Manchester will be able to raise capital to invest in city infrastructure projects on the basis that the scheme will deliver increased local business rate revenues, which will be used to repay the initial loan. This is often referred to as "Tax Increment Financing".

14 See "Greater Manchester Agreement" and "Further devolution to the Greater Manchester Combined Authority and directly-elected Mayor", available at: https://www.gov.uk/government/publications/devolution-to-the-greater-manchester-combined-authority-and-transition-to-a-directly-elected-mayor

15 The Government set a deadline of 4 September 2015 so that devolution agreements could be reached ahead of the Spending Review on 25 November 2015. See further devolution submissions sent to Government (Sept 2015). Available at: https://www.gov.uk/government/news/landmark-devolution-bids-submitted-from-right-across-the-country

16 See for instance: Department for Business, Innovation and Skills background papers, "Smart cities international case studies" and "Smart Cities: background paper", both October 2013. Available at: https://www.gov.uk/government/publications/smart-cities-background-paper

- In 2013, Innovate UK (formerly the Technology Strategy Board) founded the Future Cities Catapult, responsible for "accelerating the rate at which urban technology ideas get to market; growing the UK tech economy; and making cities better".[17] The Catapult's Cities Lab has run projects in Aberdeen, Bristol, Birmingham, Glasgow, London, Manchester and Milton Keynes (as well as overseas) that apply data science, the Internet of Things, economic analysis, predictive models and user-centred design to urban areas.[18]
- The Department of Business Innovation and Skills (BIS) has – jointly with industry and city leaders – led a Smart Cities Forum that reported to government in 2014 on the opportunities and barriers facing smart cities in the UK.[19]
- The All Party Parliamentary Group (APPG) on Smart Cities has brought members of parliament together with British academics, NGOs, businesses and representatives from local government.[20]
- Cities including Glasgow, Cardiff, Milton Keynes, Leeds, London, Bristol, Peterborough and Newcastle have all embarked on their own smart schemes, from open data initiatives to smart parking programmes, and from driverless cars to smart street lighting. Peterborough (one of four UK Future City Demonstrators) won the City Award in the 2015 World Smart City Awards.[21]
- Grants from Innovate UK and the European Union have been made available to support pilot schemes in UK cities to test new ideas and technologies.[22]

The Government hopes these initiatives will help UK technology companies capture around 10% of the $408 billion global market for smart city technologies, while also helping its cities lead the way in using cutting-edge technologies to deliver sustainable urban growth.[23]

Policy barriers to success

City devolution and smart cities hold huge potential to benefit the UK's urban areas and the people living in them. Yet both programmes face serious policy challenges and questions which, left unresolved, will significantly limit their impact. For city devolution these include:

- **Preconditions for devolving powers.** Though each city is invited to negotiate a bespoke devolution deal based on its particular local requirements, the Chancellor has stated that each must elect a city-wide mayor to be accountable for devolved powers and responsibilities.[24] Having an elected mayor may be necessary to make a success of city devolution, but is it *sufficient*? If not, what other preconditions should be set?
- **Selection and use of devolved powers.** Which powers will cities need in order to achieve the Government's stated objectives of delivering regional economic growth and public sector reform?[25] How will mayors work effectively with multiple different local authorities, public sector organisations, Local Enterprise Partnerships (LEPs) and business and citizen groups to execute those powers over a region that may never before have operated under one political unit?

17 See https://futurecities.catapult.org.uk

18 DCMS and Ed Vaizey MP, "Speech: Smart Cities – UK opportunities and potential", 21 Oct 2015, available at: https://www.gov.uk/government/speeches/smart-cities-uk-opportunities-and-potential

19 See reports of the Smart Cities Forum, available at: https://futurecities.catapult.org.uk/project-full-view/-/asset_publisher/oDS9tiXrD0wi/content/project-smart-cities-forum/?redirect=%2Fprojects

20 Available at: http://www.smartcitiesappg.com/

21 Smart City Expo World Congress, "The 2015 World Smart City Awards winners", available at: http://www.smartcityexpo.com/en/awards-2015

22 For example: Innovate UK's Internet of Things Cities Demonstrator and the European Commission's, Horizon 2020.

23 BIS, "BIS Research Paper No. 136: The Smart City Market: Opportunities for the UK", October 2013, p.2

24 The Government believes elected mayors will not only strengthen democratic accountability in UK cities, but also that they are uniquely placed to drive economic growth. Evidence from London (and indeed many other large European cities) is that mayors have been able to galvanise private investment for infrastructure projects like Crossrail and take bold and difficult decisions to achieve important outcomes, such as introducing congestion charging.

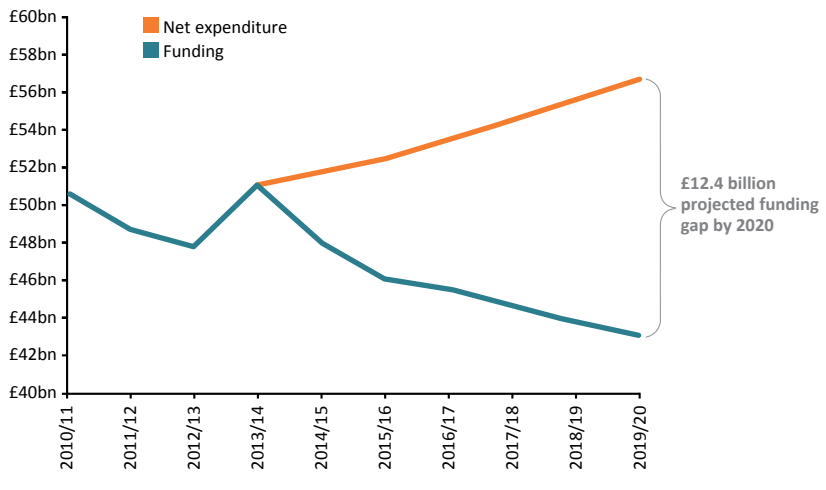
25 Some cities have pushed to have the power to raise local taxes.

- **How will central government assess if city devolution is working?** As significant new powers are entrusted to the regions, how will central government measure and assess whether city devolution is delivering the desired results in each area? How will examples of best practice be identified and shared between city regions?[26]

As for the development of smart cities, key policy obstacles include:

- **Divided political authority.** 26 of the UK's 64 largest towns and cities fall under the remit of more than one local authority.[27] This political and administrative fragmentation is problematic when the key issues smart city initiatives seek to address – such as transport, housing and energy consumption – take place at a city scale. While some local authorities are creating their own smart initiatives, such as Westminster City Council's smart parking scheme,[28] an individual council's limited geography restricts the impact these projects have on the city as a whole.[29]
- **Siloed budgets.** Budgets are siloed between different local authorities and the wider public sector covering each city, as well as between different teams within a single local authority. This budgetary fragmentation makes it difficult to invest in solutions that may benefit more than one service area or that span an entire city.[30]
- **Constrained funding.** According to the Local Government Association (LGA), councils in England face a funding shortfall of £12.4 billion by 2020, even after all future projected savings have been taken into account.[31] Though this financial pressure arguably increases the need to embrace smart initiatives that can deliver more with less, it makes it extremely challenging for councils to provide upfront capital investment in smart city solutions.

Figure 1B: LGA projections for income against expenditure for local authorities in England



26 A recent Public Accounts Committee report pointed to "a lack of monitoring and evaluation in the first wave of [City] deals, making it difficult to assess their overall effectiveness". See: http://www.parliament.uk/business/committees/committees-a-z/commons-select/public-accounts-committee/news-parliament-2015/wave-one-city-deals-report-published-15-16/

27 largest towns and cities defined as Primary Urban Areas (PUAs). See http://www.centreforcities.org/city-by-city/. London alone has 32 separate councils and the City of London.

28 See: http://www.smartparking.com/keep-up-to-date/press-releases/westminster-city-council-goes-live-with-smart-parking-s-smartpark-real-time-bay-sensor-parking-solution

29 Other cities divide responsibilities between a city and county council. For example, Cambridge City Council is responsible for areas such as planning, council housing and rubbish collections, while Cambridgeshire County Council is responsible for education, social services, transport, roads and libraries.

30 This issue was raised by the Smart City Forum, "Task & Finish Group for Infrastructure, Business Models, Finance, and Procurement", 2015. Available at: https://futurecities.catapult.org.uk/project-full-view/-/asset_publisher/oDS9tiXrD0wi/content/project-smart-cities-forum

31 LGA, "Future funding outlook for councils to 2019/20", July 2014, p.15

The need for brains *and* brawn

The principal argument of this report is that – left in isolation – each programme will be a poor shadow of what it could be. However, by linking them together, the challenges listed above can be addressed, enabling both city devolution and smart cities to deliver real reform for the UK's cities and city regions. City devolution equips mayors with extensive new powers. But those powers will fail to have impact without the tools to use them effectively; tools which smart cities can provide. Smart cities, meanwhile, offer a suite of remarkable technologies that can improve cities. But those technologies will deliver little without the right people, powers, resources and skills; things that city devolution can put in place. In short, each provides what the other needs.

The Minister of State for Culture and the Digital Economy, Ed Vaizey MP, acknowledged this fact in a speech on 22 October 2015, stating that, "smarter services support Government priorities on devolution and digital transformation".[32] Yet it is not clear in what ways the Government thinks the two agendas might influence each other in practice.

> "City devolution equips mayors with extensive new powers. But those powers will fail to have impact without the tools to use them effectively"

This report addresses that gap.

Chapters 2 and 3 demonstrate exactly how smart cities can give the new generation of elected mayors the data tools and insights they require to deliver city devolution's objectives of boosting regional economic growth and improving the efficiency and effectiveness of local public services. Chapters 4 and 5 explain how city devolution can address the political, leadership and funding barriers that hinder the development of smart cities.

Overall, the report makes the case that if the UK wants its cities to thrive, they must have both brains *and* brawn. Tools *and* powers.

Smart devolution.

Recommendations

Coordinating government policy in support of the UK's cities

Recommendation 1: The Government should recognise the mutual dependency between city devolution and smart cities and ensure its policies towards both are coordinated. A key part of the negotiations with the 15 cities that applied for devolved powers as part of the Spending Review 2015 process should be requiring cities to outline how they will use smart measures to ensure they meet the goals of boosting regional economic growth and improving local public services.

32 DCMS and Ed Vaizey MP "Speech: Smart Cities – UK opportunities and potential", 21 Oct 2015, available at: https://www.gov.uk/government/speeches/smart-cities-uk-opportunities-and-potential

Box 1: International examples of smart cities

Cities all around the world are turning to technology and data to solve some of their most pressing urban challenges. Some, like Rio de Janeiro, seek to use such "smart city" technologies to address problems related to crime and deprivation, such as that found in the Brazilian capital's poverty-stricken favelas. Others battle challenges borne from their success; managing the pressure on public services, energy, transport and housing that comes from their growing and ageing populations. More than half the world's population lives in urban environments and the figure is expected to rise to 75% by 2050.[33]

As diverse as the cities themselves and the challenges they face are, has been the way they have gone about applying technology to become 'smart'. Key examples include:

Masdar (United Arab Emirates) and Songdo (South Korea) have been built as entirely new cities, with cutting-edge smart technologies inserted by design into the architecture, infrastructure and open spaces. The latter has a network of waste disposal pipes feeding into processors that automatically sort waste from recyclables.

Barcelona has run numerous different projects to retrofit new technology onto the city's existing infrastructure. Smart street lighting prioritises illumination in the busiest pedestrian areas, while bus stops with interactive screens help people to navigate around the city.[34]

New York has pioneered a comparatively low-tech approach. Under Mayor Michael Bloomberg, City Hall set up an analytics team to source data from more than 40 departments and agencies to spot correlations and increase the coordination and targeting of public resources.[35]

In Chennai (India) communities have literally been putting themselves on the map, using smartphones to record the locations of slum dwellings that had not officially been recognised by the government.[36]

In cities around the world, from London to San Francisco, so-called "on-demand" and "sharing economy" companies such as Uber and Airbnb are using digital platforms to change the way people interact with each other, enabling them to exchange their services, time and assets, offering an alternative to ownership.

See Appendix for a selection of case studies of UK smart city initiatives.

33 Arup, 'Delivering the Smart City', November 2014, p.14

34 VilaWeb, "Ten Reasons Why Barcelona is a Smart City", 26 February 2014, available at: http://www.vilaweb.cat/noticia/4175829/20140226/ten-reasons-why-barcelona-is-smart-city.html

35 For a detailed account of this case study, see: Capital City Foundation, "Big Data in the Big Apple: The lessons London can learn from New York's data-driven approach to smart cities", June 2015.

36 See: http://www.transparentchennai.com/tag/community-mapping/?catID=1. The Chennai Corporation has now adopted the same approach in a way that some citizens are less happy about, as discussed here: http://timesofindia.indiatimes.com/city/chennai/Chennai-Corporation-makes-another-bid-to-digitally-map-city/articleshow/44929164.cms

2
City Devolution and the Data Deficit

"If you can't measure it, you can't manage it."

Michael Bloomberg

It is the day after the mayoral election.

The victor convenes a meeting of the city region's local authorities, public sector bodies, Local Enterprise Partnerships (LEPs) and citizen groups. Opening the session, the new mayor highlights the most important question on the agenda. How will these bodies – that have never before been part of one political unit – work together to deliver the two key aims of city devolution: boosting the region's economic growth, and innovating to reform local public services?

It will very soon become apparent that what they need is *data*.

Data will be required to **identify** the scale and location of the problems they seek to tackle and the demand they aim to meet across the city region. Where are the areas of urban deprivation? What is the exact distribution of demand for bus and tram services? Where would investment money best be spent to support the growth of new businesses?

> "It is hard to overstate the importance of data to the city devolution agenda"

Data will be required to **execute their powers** effectively. As Policy Exchange explored in "Small Pieces Loosely Joined", many of the best tried-and-tested ways of increasing the efficiency and effectiveness of public services – joining up services across local authority boundaries, intelligently coordinating activity between different public sector partners, predicting and preventing problems from occurring – require making smarter use of data.[37]

Finally, data will be required to **measure and report** on the results achieved with the newly devolved powers. Mayors will want to have accurate information to monitor whether their activities are producing the desired results. Likewise, central government will demand data to assess whether its key objectives for city devolution are being met, a requirement it has already specified for Greater Manchester.[38]

In short, it is hard to overstate the importance of data to the city devolution agenda.

37 Policy Exchange, 'Small Pieces Loosely Joined: How smarter use of technology and data can deliver real reform of local government', January 2015.

38 Pages 5 and 6 of the following document on Greater Manchester's devolution agreement mentions how Government expects to carry out "evaluation and economic assessment" of devolution: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/369858/Greater_Manchester_Agreement_i.pdf

The data deficit

This observation points to a serious challenge. With very few exceptions, UK cities have failed to put in place even the most basic mechanisms to join up, analyse and act upon the vast quantity of data they already have. Even London's City Hall does not systematically collect data from the 33 London boroughs over which it presides, other than that required for statutory purposes, such as population and school place statistics. The information used by the Mayor of London to shape decisions is therefore largely based on data collected by parts of central government, such as the Department for Work and Pensions (DWP).[39]

> "With very few exceptions, UK cities have failed to put in place even the most basic mechanisms to join up, analyse and act upon the vast quantity of data they already have"

Three main factors explain why UK cities fail to use data effectively:

1. **Data silos.** Local authorities and public sector organisations hold their own data separately, recorded in a variety of formats and according to various data standards in many different IT systems. Even within a single local authority, data about one citizen can exist on 20–30 separate databases with no unique identifier (such as a National Insurance or NHS number) to connect them. The resultant difficulty in searching existing datasets (or knowing that they exist in the first place) prevents cities from seeing which data might be brought together and analysed to improve a service outcome.
2. **Legal and cultural barriers to data sharing.** Public sector bodies tend to commission their own independent legal advice, frequently resulting in each organisation having a different interpretation of the same data protection legislation.[40] Data sharing will be limited by the most cautious organisation in any group. Compounding this problem is the fact that the senior data officials in most public sector organisations are *data protection officers*, whose primary training and inclination is towards protecting (rather than finding ways to responsibly share) data.
3. **Lack of data skills.** Data skills are widely understood to be a vital competency for running a modern city. Yet an April 2014 survey of local authorities conducted by BT showed that only 7% of those questioned strongly agreed that such skills existed at sufficient levels within their organisation (see Figure 2A).[41] While some cities have chosen to solve the data-skills problem by hiring private sector partners who can interpret data for them, this approach by itself is unlikely to be sufficient. Deriving real value from data requires knowing what questions to ask (indeed, what questions *can be asked*) in the first place. It is therefore highly problematical if cities lack their own minimum set of in-house data skills.

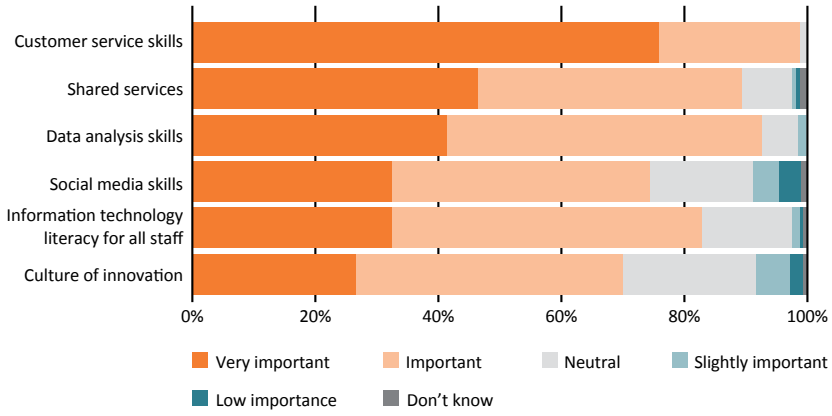
39 Policy Exchange original interview with GLA Intelligence team, 2015.

40 E.g. the Local Government Act 1972; Social Security Administration Act 1992; Data Protection Act 1998; Welfare Reform Act 2012 and relevant EU legislation.

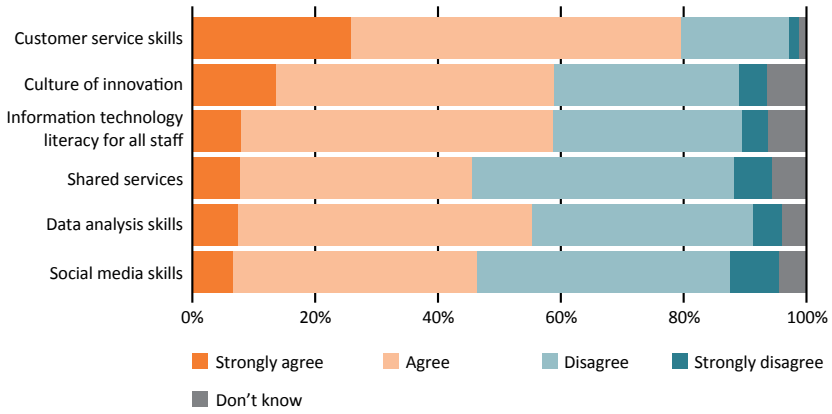
41 Source: BT, 'Public services: delivering the next generation of change', April 2013, p.4&6, http://connect.bt-comms.com/Dods-whitepaper.html

Figure 2A: Importance and presence of data analysis skills in Local Authorities

How important do you think the following skills are for improving the delivery of public services?



To what extent do you agree that these skills exist at sufficient levels within your organisation at present?



Source: BT, 'Public services: delivering the next generation of change', April 2013, p.4&6, http://connect.bt-comms.com/Dods-whitepaper.html

Given the vital importance of data to the success of city devolution, finding solutions to these three problems should be a policy imperative for government. Happily, *this is exactly where smart cities can help*. And while there are many different models of smart cities (see Chapter 1, Box 1) there is one that addresses all the challenges listed above. That model is the New York City Mayor's Office of Data Analytics.[42]

The Mayor's Office of Data Analytics

Having made his fortune providing data-driven analytics for the financial sector, when he became Mayor of New York (2002–2014) Michael Bloomberg wanted to prove that the same techniques could benefit cities, too. To that end, he created the Mayor's Office of Data Analytics (MODA).[43] MODA is a team of just nine people, based in City Hall, who have the capabilities, technical resources, skills and leadership support to combine, map and interrogate data from around 40 separate city organisations across New York's five boroughs. The team's work to support the New York Fire Department (FDNY) provides a powerful illustration of what the model can achieve.

42 The New York model described in this chapter has been explored in detail by the Capital City Foundation: "Big Data in the Big Apple: The lessons London can learn from New York's data-driven approach to smart cities", June 2015.

43 See: http://www.nyc.gov/html/analytics/html/home/home.shtml

Fighting fires before they start

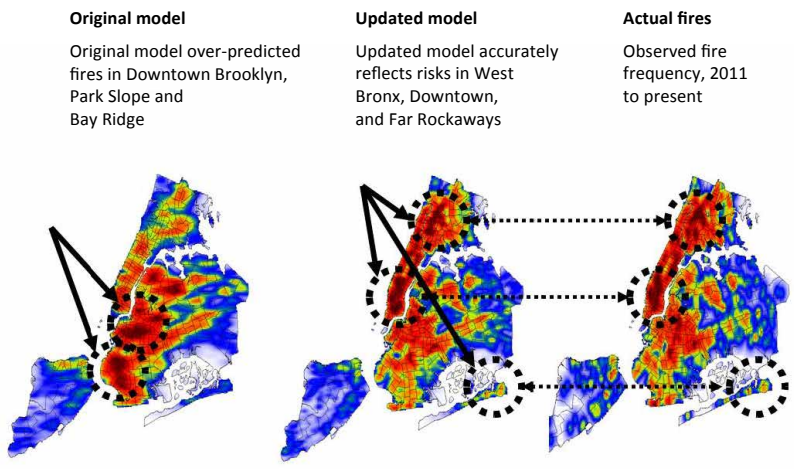
To understand how a city really works, just ask front-line staff, says MODA's first director, Mike Flowers (see Appendix for Policy Exchange's full interview with Mike Flowers). In his own words:

> *"Veteran fire fighters know what dangerous buildings look like. They know how important it is for a building to have an operable sprinkler system, the impact that the improved building and fire codes have had over centuries of construction, and what type of business activity is most frequently correlated with dangerous fires. If you ask a veteran of the fire department, their gut can give you a list of criteria for dangerous buildings nearly as effectively as a statistical regression."*[44]

MODA's challenge was to see if better data could complement and strengthen fire fighters' natural intuition in identifying dangerous buildings. Could accessing datasets held by organisations outside the Fire Department (e.g. data on property taxes) be useful to their work? Could the factors underpinning fire fighters' gut instincts (the age of the building, the type of business, and so on) be quantified more precisely with data? Where previous versions of the city's fire risk model had weighted the criteria based on focus group discussions with fire fighters, MODA tested them against data from actual past fires to calculate their relative importance.

Using this data-driven approach, MODA created a model that could predict which buildings were most at risk of having serious fires with far greater accuracy. Figure 2B illustrates the difference. On the left is a map showing the results of the original fire prediction model. The map in the centre shows the predicted location of fires according to MODA's model. On the far right-hand side is where past fires had actually occurred. The contrast is striking. Whereas the old model failed to identify high-risk zones in areas such as Harlem, Downtown Manhattan and the Rockaways, the new model very closely reflected reality.[45]

Figure 2B: Location of fires as predicted before and after the use of MODA's model



Source: NYC – Mayor's Office of Data Analytics, 'Annual Report 2013', December 2013, p.14.

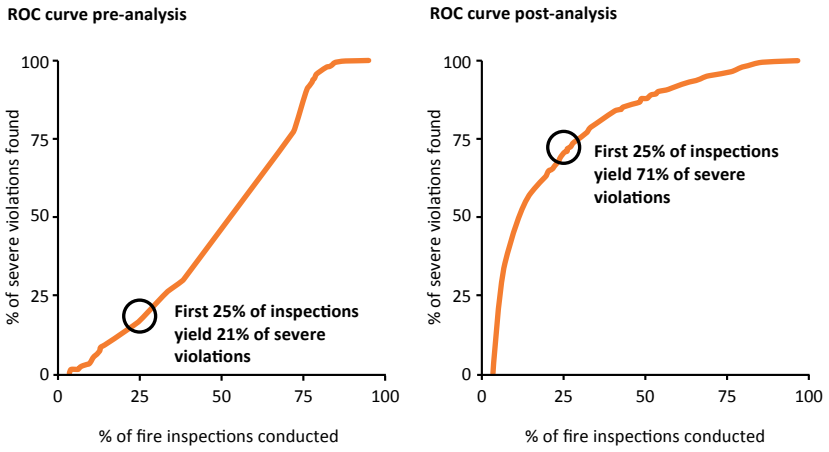
Deriving these insights provided intelligence that could be acted upon immediately. Every year, FDNY proactively inspects more than 25,000 buildings

44 NYC – Mayor's Office of Data Analytics, 'Annual Report 2013', December 2013, p.14

45 NYC – Mayor's Office of Data Analytics, 'Annual Report 2013', December 2013, p.14

that it believes may be at risk of future fires. As Figure 2C shows, prior to applying MODA's data-driven analysis, the first 25% of FDNY inspections typically resulted in 21% of the most severe violations being discovered. Using MODA's prediction model, the first 25% of inspections now result in more than 70% being discovered. Though the total number of inspections remains the same (FDNY is obliged to investigate every complaint it receives), by going to the most dangerous buildings first, the department is able to reduce the risks posed to New Yorkers.

Figure 2C: Percentage of dangerous buildings identified in first 25% of inspections



Source: NYC – Mayor's Office of Data Analytics, 'Annual Report 2013', December 2013.

A model for the UK?

The specific example of fire fighting has direct relevance for UK city devolution since (at least if Manchester is to be a model for other cities) newly elected mayors will have responsibility for fire services in their region.[46] Furthermore, the experience of New York demonstrates that the MODA model could support several of the likely priorities of UK city mayors.

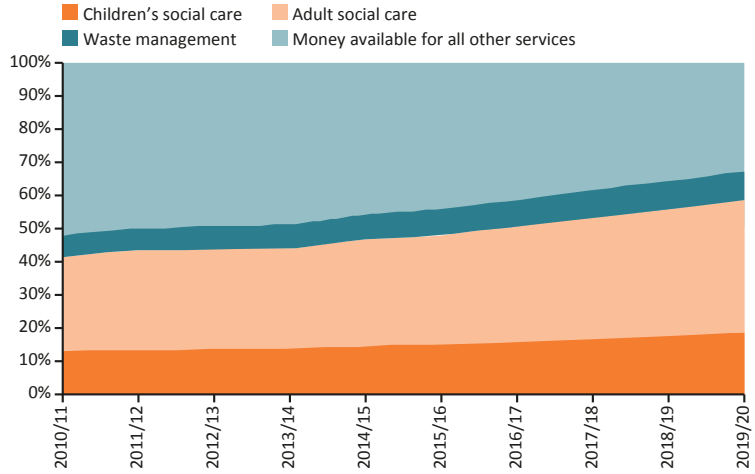
- **Supporting new business growth.** MODA measured the time it took for new businesses to open in order to assess the effectiveness of New York's New Business Acceleration Team (NBAT). By matching datasets from different city and commercial databases, MODA was able to track the average amount of time it takes for businesses to complete all steps of the regulatory process. It found that companies that took advantage of NBAT's services opened their doors 79 days faster than those that did not, a 36% reduction in time-to-open.[47] With this information, New York's City Hall can pursue other measures based on empirical evidence that can support the city's businesses. A similar capability would help UK mayors work to promote their regions' economic growth.
- **Supporting vulnerable families.** Adult and child social care are expected to take up almost 55% of local authority spending by 2020 (see Figure 2D). Any meaningful attempt at public sector reform in city regions must therefore look for ways to improve and reduce the cost of this work. In New York, MODA helped Mayor Bloomberg's successor, Bill de Blasio, to effectively target

46 HM Treasury, "Further devolution to the Greater Manchester Combined Authority and directly-elected Mayor", 3 November 2014, p.3. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/443087/Greater_Manchester_Further_Devolution.pdf

47 NYC – Mayor's Office of Data Analytics, 'Annual Report 2013', December 2013, p.19

initiatives aimed at helping vulnerable families. For example, they used smart data techniques to combine records from multiple different public sector organisations to focus advertising of free pre-kindergarten places to the low-income families who most needed them.[48]

Figure 2D: LGA breakdown of local authority spending in England 2010–2020



Source: LGA, "Future funding outlook for councils from 2010/11 to 2019/20", July 2013, p.5. Available at: http://www.local.gov.uk/c/document_library/get_file?uuid=b9880109-a1bc-4c9b-84d4-0ec5426ccd26&groupId=10180

- **Modelling and measuring effectiveness.** The MODA team uses the data it collates to model the impact of proposed new legislation, enabling initiatives to be tried and tested virtually before being rolled out in the city (see case study in Box 2). In the UK, this information would help city mayors to model, measure and report on their progress to government.

Box 2: Case study on modelling legislation – Organic Recycling Bill

MODA worked with the Mayor's Office of Long Term Planning and Sustainability (OLTPS) to estimate the percentage of businesses that would be affected by various environmental initiatives to encourage composting, and to estimate the amount of organic matter that would be generated under those proposals.

MODA started by using its data on businesses to create a list of all the waste-generating firms in New York City, and to categorise them by type and size.

Next, MODA used previous research from the Department of Sanitation (DSNY) and the Business Integrity Commission (BIC) to find accurate estimates of waste by business type.

MODA then conducted analysis to determine which business characteristics were most reliable in predicting waste behaviour.

Once the model was tested, MODA fed in difference legislative scenarios that were being considered.

Finally, MODA took the output of the model, and developed charts that communicated the estimated impact of different policy decisions. These were used by OLTPS in its discussions with the City council in setting the specifics of the Organic Recycling Bill.

Source: NYC – Mayor's Office of Data Analytics, 'Annual Report 2013', December 2013, p.21–22.

48 See: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2610694

It is not hard to see the benefits that the MODA smart city model could offer UK cities seeking to make a success of devolution. It provides a simple and effective mechanism to address the challenges listed at the start of this chapter: removing data silos, improving data visibility, creating a safe mechanism for sharing data responsibly, legally and ethically, and putting in place a core group with the skills and resources to use data to achieve economic growth and public sector reform. It would enable mayors and public sector leaders to access analysed data from across their whole city region so they could identify the scale problems and service demand, reform public services, and measure and report on their success to central government.

For all these reasons, as a prerequisite of receiving devolved powers, central government should require (and proactively support) each city region to set up their own Office of Data Analytics (ODA), led by a Chief Analytics Officer reporting directly to the mayor.[49] As part of the devolution process, central government should also establish a dedicated team responsible for "data devolution". Cities and city regions should be able to request access to datasets held by central government that support them in managing their devolved powers. For example, Bristol successfully negotiated access to higher level census information to better understand the city's population, as well as data from DWP on local job seekers.

Box 3: Advice from Mike Flowers, Founding Director of New York City MODA team to UK cities

"Every locality generates data. It's impossible at this point not to be generating data because you probably have a utility system that generates water, because you've got to bill them somehow. You have an ambulance service. You have a fire service. You have a police service. You have businesses that are licensed in your town. You've got roads that people travel, etc. etc. etc.

"You actually have in those a tremendous untapped resource [the data] that you can look to to solve the problems that you're facing in terms of meeting your obligations to deliver those services. So I'd tell cities the first step to becoming smarter is to look inward. The answers really are already there. They just need to decide to take that first step [by creating a MODA team]."

Source: Mike Flowers interview with Policy Exchange 16 October 2015. See Appendix for full transcript.

Low barriers to entry

Establishing Offices of Data Analytics need not be onerous or expensive. New York's started with just two people using little more than Excel spreadsheets. Nearly all local authorities already have data analysts in their performance, policy and data teams. These existing staff could form the core personnel of new ODAs. Additional personnel could be found in the form of students from local universities studying data or smart-city related courses (such as those at UCL's Centre of Advanced Spatial Analytics),[50] giving them the chance to solve real world problems with real city data.[51] This approach has been used effectively by Boston's New Urban Mechanics team,[52] and by New Orleans' Office of Performance and Accountability.[53]

49 The area over which an ODA team operates can be flexible. Several neighbouring cities could create and share a single ODA to serve their wider region.

50 See: http://www.bartlett.ucl.ac.uk/casa

51 Staff could also potentially be sourced from the Open Data Institute and the Digital Economy, Transport and Future Cities Catapults.

52 Boston New Urban Mechanics: http://newurbanmechanics.org/boston/

53 The New Orleans Office of Performance and Accountability has a function very similar to New York's MODA, and has partnered effectively with Louisiana State University. See: http://www.nola.gov/performance-and-accountability/

Central government departments such as the Cabinet Office, the Department for Communities and Local Government (DCLG), the Department for Business Innovation and Skills (BIS) and the Department for Culture Media and Sport (DCMS), have a major interest in the success of the MODA model and should provide matched funding to establish them in the UK. The Cabinet Office would benefit from ODAs' valuable insights on data sharing and analytics – an area being explored by the Government Digital Service and Government Innovation Group. DCLG would benefit from ODAs' work on encouraging greater collaboration between local public sector partners. BIS and DCMS could benefit from using them as pilots for the development of data-driven smart city policies.

Critics may point out that New York's political system is very different from that in the UK, and hence the MODA model may not translate to a UK setting. There are two responses. First, there is already evidence that MODA's techniques can work effectively in the UK. On a smaller scale, Newcastle and North Tyneside councils are working together on joint data initiatives. The London Fire Service already uses data mapping techniques to target the distribution of fire safety awareness information at areas of highest risk.[54] Camden Council combines records on its citizens from 16 different line-of-business systems to create a single resident index to better address individuals' needs. All these examples should provide inspiration to UK local authorities, cities and public sector organisations seeking to make better use of their data. All will need to operate on a much larger scale if cities are to deliver on the promise of city devolution.

Second, it is true that MODA works well in New York because the city has a mayor with powers and budgetary responsibility over important policy areas. But that is precisely why city devolution will be so important to the success of the UK's smart cities in return – an argument explored in detail in Chapter 4.

Box 4: Case study – North East use of data

A collaboration between Newcastle University and Newcastle City Council has seen the development of Science City; a central hub for innovation and new urban technologies. Part of this initiative is the Cloud Innovation Centre (CIC) which works with public and private organisations to exploit value from the information and data they already gather. The CIC's role has been to help cleanse datasets, broaden the organisational awareness of the value of data, and ensure that data is put to use and shared persistently.

For example, the CIC worked with Newcastle City Council's Urban Traffic Management Centre to assess its data. The organisation uses sensor, survey and purchased data to manage real-time traffic flows and plan future improvements to the city's road network. Limited by organisational silos, lacking standards and without the technical capability to make use of bespoke data reporting software provided by a vendor, the Centre's data was not being put to best use. The CIC installed a common data management layer which began to clean and join up the array of data across the organisation. The result was not only an improvement on the existing information provided to the Urban Traffic Management Centre, but it also enabled new applications to be developed and for the data to be shared externally with other organisations and the public.

54 The London Fire Brigade (LFB) serves a population of 7.5 million people in 3.2 million households across 1,537 square kilometres. LFB worked with the technology company SAS to predict which households in London are at the greatest risk of fires so that they can conduct safety checks, give advice and fit smoke alarms to prevent fires before they happen. More than 60 different data elements feed into the SAS model, including census data and population demographics, broken down into 649 geographical areas (ward level), plus type of land use, data on deprivation, Mosaic lifestyle data, historic incidents and past prevention activity. The ability to prioritise inspections is vital. LFB already conducts 65,000 home safety visits a year, but at that rate visiting all London properties would take more than 50 years. Results, provided as user-friendly maps showing predicted incident levels, are mainly used at fire station level. Borough Commanders and local firefighters use these insights to plan and target home visits in areas of highest risk. View the full case study at: www.sas.com/en_gb/customers/london-fire-brigade.html

Summary

To be able to identify where they need to act, execute their responsibilities, and measure and report on their progress, the new generation of elected city mayors will need the tools to match their new powers. Without them, mayors will be driving blind and risk falling far short of the Government's aspiration to deliver regional economic growth and local public sector reform. Smart cities – specifically the smart, data-driven model pioneered in New York City – can provide the required tools. Yet there is no reason why the UK should stop merely at adopting New York's smart city MODA model. After all, city devolution will require working with – and empowering – individuals and organisations far beyond just the public sector. How to do that is the subject of the next chapter.

Recommendations

Using existing public sector datasets to effectively deliver devolved powers

Recommendation 2: As a pre-condition of receiving devolved powers, cities/city regions should be required (and supported by central government) to establish an Office of Data Analytics (ODA), led by a Chief Analytics Officer, reporting directly to the mayor. Each ODA should be tasked with helping the mayor and the city region's public sector bodies to harness analysed data to: 1) identify the scale and location of the problems they seek to tackle and the demand they aim to meet; 2) execute their powers effectively to enable regional economic growth and local public sector reform and; 3) measure the impact of devolved initiatives so policies can be refined and scaled. Matched funding for ODAs should be provided by central government departments.

Measuring and reporting on the use of devolved powers

Recommendation 3: The Government should require ODAs to provide data on how newly devolved powers are delivering against city devolution's objectives. This data should be published nationally in an annual report to encourage best practice to be shared between cities.

Opening central government datasets to aid city devolution

Recommendation 4: Central government should establish a dedicated team responsible for "data devolution". Cities and city regions should be able to request access to datasets held by central government that support them in managing their devolved powers.

3
The City Data Marketplace

The previous chapter argued that establishing an Office of Data Analytics (ODA) in each city region should be a prerequisite of receiving devolved powers. Yet, with its primary focus on public sector organisations and their data, the ODA model is just a first step. It ignores a big question: how can city authorities collaborate effectively with the many other individuals, volunteer groups and organisations on whose combined activity a city's success depends? For many cities, an answer has been sought through the use of open data.

Definition: Open Data

Open Data is data that is made freely available to everyone to use and republish as they wish, without restrictions from copyright, patents or other mechanisms of control. The datasets tend to be (though not exclusively) those held by government and public sector organisations, and are released through online portals such as data.gov.uk and the London DataStore (http://data.london.gov.uk/).

Open, but not always effective

The UK government's three stated aspirations for open data overlap heavily with those for city devolution. Open data can spur commercial innovation (and therefore economic growth) by enabling citizens and businesses to create new data products, such as CityMapper, Check That Bike and Geolytix.[55] Open data can also support the development of more efficient public services since external developers can use it to create products and services that reduce demands on the public sector.[56] Finally, open data can increase civic engagement and strengthen local communities by enabling citizens to make innovative use of data. One such example is how volunteers in New York City have used web tools to identify, catalogue and make greater use of underdeveloped, publicly-owned land in a scheme known as 596 Acres.[57]

Despite these very clear benefits, the current approach taken by many UK cities hinders those outside government – and especially those in the private sector – from using open data. Three issues stand out:

1. **No guaranteed supply of data**. Imagine an entrepreneur who stands in front of a panel of angel investors. The entrepreneur explains that (s)he has an idea for a brilliant business but it relies on one resource, available from just one supplier, and that comes with no guarantees of quality, timeliness or future

55 See: https://citymapper.com/london, https://checkthatbike.co.uk/, and geolytix.co.uk

56 The UK government has explicitly tied open data to the smart city agenda. BIS published: "Smart Cities: Background Paper" which notes that in overseas case studies open data has been a key success factor in the smart city agenda. See: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/246019/bis-13-1209-smart-cities-background-paper-digital.pdf p.37. This point has also been made by smart city expert, Rick Robinson: http://theurbantechnologist.com/2015/02/15/6-inconvenient-truths-about-smart-cities/#market

57 See: http://596acres.org/

provision. Investors would be wise to avoid such a business. And yet this is precisely where many cities' approach to open data leaves businesses that wish to use public sector information. Few entrepreneurs or investors will be willing to risk their own time and resources to build products if the data they rely upon cannot be guaranteed.

The reason no such guarantees are made is because the UK's "get it out and see what other people do with it" approach to open data is financially unsustainable. Releasing open data is not cost-free. It can require investment in new or updated software, potentially the creation and maintenance of a web portal or the development of APIs. Most importantly, it requires the resource time to annotate the data and to provide sufficient support for those who wish to use it. The fact that HM Treasury may eventually receive extra tax revenues from data-fuelled businesses does not help the budgets of the organisations that provide the data in the first place. Given the current pressure on public sector finances, it is not implausible that some councils may cease providing open data altogether if they see it as nothing more than a cost centre.

> "The UK's 'get it out and see what other people do with it' approach to open data is financially unsustainable"

2. **Too small scale to be viable.** Though a small number of local authorities make use of combined open data portals, such as data.gov.uk or the London DataStore, the majority release open data separately and in non-comparable formats. This fragmentation disincentivises app developers from building products because the data covers too small an area to provide a large enough potential customer base – especially when the typical price of an app is around 69p. To be viable for a business and useful to users, data needs to be available *at least on a city level*. One reason TfL apps have been so successful is that they can appeal to London's eight million residents, as well as those that commute into the capital.

3. **Poor data quality.** While some developers can work with poor quality data, it raises the barriers to doing so. Without further standardisation, there will be an artificial limit on the number of businesses that have the time and resources to build useful products.

The case study of AppyParking (see Box 5) highlights the negative impact these shortfalls can have for businesses wishing to create smart, city-scale services with open data.

Box 5: Case study – AppyParking

Dan Hubert was driving into London's West End to see a show. He circled the roads around the theatre several times trying to find a parking space. The only one available near the venue was on a single yellow line. He looked around and tried to find a sign that showed whether the bay was residents' parking only, and if not, what the timing restrictions were. Finding nothing, he assumed he would have to move on. Fortunately, he spotted a passing traffic warden who said he was, in fact, able to park there.

It was then that Hubert realised that London must be filled with hundreds of parking spaces that go underused because people are confused about the rules for each street and are cautious about getting a ticket. Their confusion is understandable: there are more than 1,800 individual controlled parking zones across the capital, each governed separately by the 32 boroughs. One zone may have a restriction from, say, 9am–5pm, while an adjoining street may be 8.30am–11pm. Searching for a space is an inefficient use of drivers' time, can increase congestion and is bad for the environment. Might there be a better way?

Hubert's idea was to create an app called Yellow Line Parking (now AppyParking), that can pinpoint a person's location and give them all the information they need about available parking spaces anywhere in the capital.[58] To create it, he contacted each London borough to ask for data on their street parking restrictions. After considerable negotiation with each council, he eventually sourced the information he needed. But it was here that the problems started.

First, he quickly discovered that every borough records their information in different styles, much of it in hard-to-use formats such as images of maps in PDF documents. Undeterred, Hubert invested his own time and money in building 'The Parking Platform' – a tool that could handle all the different data styles to create the UK's first standardised dataset on parking restrictions. He then fed the data into a single app that covers the whole of the London. At the time of writing, he and other backers have invested more than £250,000 to bring the service to London's residents and visitors.

Second, while some councils have improved the quality of their data in the two years since Hubert started his venture, others – including Kensington and Chelsea, Barnet, Havering, Lambeth and Barking and Dagenham – have said they will no longer share their data, in some cases because they may wish to develop their own parking apps.

As Hubert seeks to raise a further £1m to extend AppyParking across the rest of the UK, he wonders whether councils' reluctance to share records could derail his plan.

Fortunately, all three issues can be resolved by putting in place ODAs (see Chapter 2). By adopting the model of New York's MODA team, cities would develop the expertise and ability to generate real value and cost savings from their own data. As a result, they would have a direct financial incentive to invest in the accuracy, timeliness and usability of their own information. As in New York City, each ODA would then be responsible for releasing a subset of the data they use for themselves as open data covering *the entire city*. Doing so would remove the disconnect between the payers and beneficiaries of open data, making it financially sustainable for the long term, as well as improving the quality of the open data available to businesses, charities and citizens. Given open data's potential to

58 See: http://www.appyparking.com/

support the goals of city devolution this is yet another reason why ODAs should be a prerequisite of receiving devolved powers.

Yet there remains one serious problem that even the ODA model does not solve.

From open data to city data

Look at some of the most transformative new operating models used by the likes of Wikipedia, Twitter and TripAdvisor, and it is evident that their value comes from sourcing data from *outside* their organisation. In light of this, most UK cities' approach to open data can be seen to have an additional shortfall: the flow of information is in just one direction. Businesses, charities and citizens can receive data *from* government. But – with a few notable exceptions such as the Leeds Data Mill[59] – there are few official, standardised and automated mechanisms to provide data *to* government. That is a huge missed opportunity. Below are examples of how external sources of data could be of enormous value to mayors and city authorities in tackling important urban issues such as improving citizen health and safety, promoting economic growth, and tackling congestion.[60]

> "Most UK cities' approach to open data can be seen to have one additional shortfall: the flow of information is in just one direction"

1. **Reducing cycling deaths and serious injuries**

   In 2014, 431 people were involved in serious cycling accidents on the streets of London. Thirteen died from their injuries.[61] Each incident is tragic in and of itself, but additionally the fear of injury is the primary reason preventing more Londoners from taking up cycling in the capital. A major goal for London (and many other UK cities) is to improve road safety, both to save lives and also to encourage take-up of cycling to improve the city's health, sustainability and congestion. In this, data can help.

   Transport for London has worked with the Metropolitan Police to analyse accident report data to identify particular danger spots across the capital.[62] The data shows that, despite comprising a quarter of the road network, junctions are the site of more than three quarters of all cycling accidents. Moreover, though Heavy Goods Vehicles (HGVs) represent just 4% of vehicles on London's streets, over half of all cycling deaths from 2010–2013 were caused when an HGV turned left across the path of a cyclist.[63]

   Yet TfL's data on the routes taken by cyclists is very limited. Sourced from just 60 sensors embedded on streets within the TfL Road Network (which itself accounts for just 5% of London's roads), it is only detailed enough to provide rough estimates of the number of cyclists and the routes they take.[64]

   Data collected by the private sector could help. Citi Logik (which has access to data from Vodafone) can apply algorithms to mobile phone signals to tell whether a person is walking, driving or travelling by bike. As a result, they can create live or retrospective maps of actual cyclist movements anywhere in the capital.

   As for HGVs, large freight companies already track their vehicles using GPS in real-time to optimise their routes. The Mayor of London could rule that a condition of driving into the London Congestion Zone for HGVs is that they share their GPS data with the London Office of Data Analytics. This would not

59 See: http://www.leedsdatamill.org/

60 Many further examples could be given of how business data could be of value to the public sector and citizens. The idea is clearly gaining credence, with companies such as Google setting up Sidewalk Labs – a project to use technology and data techniques to improve cities.

61 London DataStore, "Pedal Cyclists Casualties, killed and seriously injured". Available at: http://data.london.gov.uk/dataset/pedal-cyclist-casualties-killed-and-seriously-injured/resource/cebb2927-f8df-45f3-bf25-13ec778cd959

62 Though the likelihood of injury during any given cycle journey is roughly 11 million-to-one, some routes carry far greater risk than others.

63 Greater London Authority, The *Mayor's Vision for Cycling in London,* March 2013.

64 See http://data.london.gov.uk/dataset/cycle-flows-tfl-road-network

be cost-prohibitive for firms with smaller fleets: simple GPS tracking apps are available for as little as £4 from the Google and Apple app stores. Working with TfL, the London ODA could map common routes used by both cyclists and HGVs in real-time, noting the most frequent locations where HGVs turn left across popular routes used by cyclists.

Armed with this detailed information, city leaders would immediately be able to put in place policy responses to reduce accidents, whether that be imposing restrictions on the routes taken by HGVs through the city (or at least at peak cycling times during the day), prioritising spending on new bike lanes, or regularly updating cyclists on the city's most dangerous routes via apps.[65] Unlike the city's historic data, this would enable policy to keep pace with reality on the ground, particularly as the routes taken by HGVs changes with large construction projects such as Crossrail and the Thames Tideway Scheme.

2. **Supporting business growth and economic activity**

Supporting businesses will be vital if cities are to achieve the government's aim of spurring regional economic growth. So where is the best place to start a business? This was a question asked by a record-breaking 581,173 businesses that registered with Companies House in 2014. For those that rely on footfall, coming up with an answer is vitally important. If a business owner cannot afford the rents charged by a city's busiest high streets, how can they find out which other locations provide a sufficient flow of potential customers? While large retailers can afford to pay for market research, it is start-ups and small businesses that lose out by having to rely on intuition rather than data. Again, data held by businesses could help. For example:

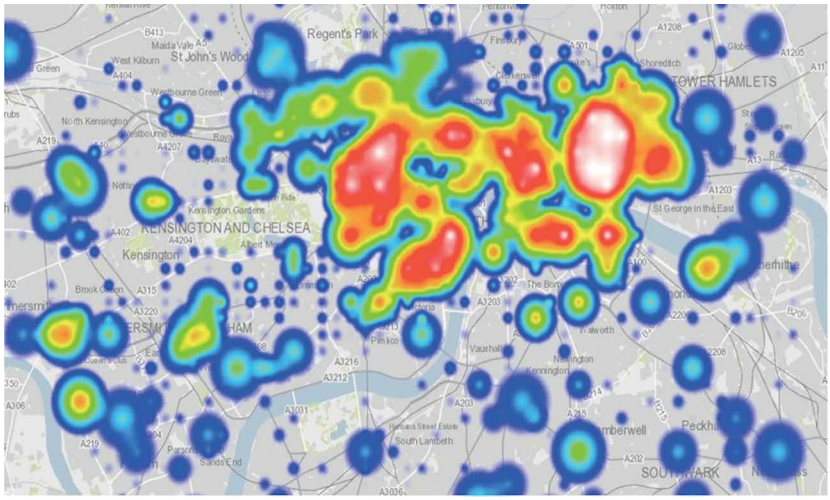
- **Mobile phone data.** Mobile phone operators and technology companies such as Google and Apple collect a considerable amount of data about the location of mobile phone users. That data could be aggregated to show how many people have walked down a particular street during the course of each day, week or month. It could even show average flows of people at different times of day, or days of the week, to help businesses optimise their opening hours. Such maps would not show any individual's end-to-end journey, and streets where fewer than, say, 100 people had walked could appear blank so that no individual could be identified. A similar technique has been trialled in Boston where the taxi app company, Uber, has made anonymised data on journey routes and times available to the city authorities.[66]
- **Electronic payments data.** With more than 75% of all spending in the UK retail sector made using credit and debit cards, companies like MasterCard collect vast amounts of consumer data and model it for economic, business and client services.[67] Aggregated and anonymised to high levels of security, this data could be useful both for city governments and new businesses in understanding patterns of consumer behaviour within a city. It could show where certain types of products are favoured, supporting business owners in deciding where to set up shop.

65 A recent project by the Future Cities Catapult uses an app to re-route cyclists along paths with the least pollution. A similar approach could be applied to direct cyclists along the safest routes/those with the smallest number of HGVs.

66 Wall Street Journal, 'Uber Offers Trip Data to Cities, Starting With Boston', 13 January 2015, available at: http://blogs.wsj.com/digits/2015/01/13/uber-offers-trip-data-to-cities-starting-in-boston/

67 CreditCard.com 'UK credit and debit card statistics', 30 January 2015, available at: http://uk.creditcards.com/credit-card-news/uk-britain-credit-debit-card-statistics-international.php

Figure 3A: Heat map showing pedestrian density in Kensington and Chelsea

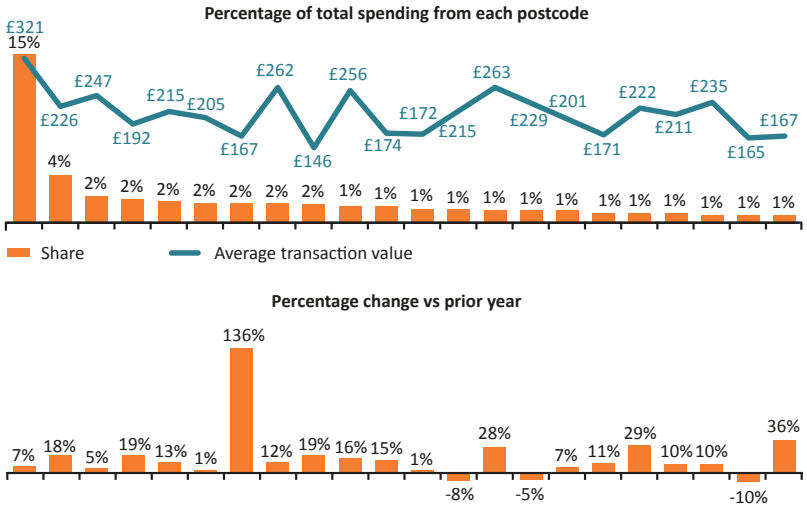


Heat map created from aggregated and anonymised mobile phone data showing pedestrian densities at 19:20. This type of map would be used to give a very high-level view of pedestrian demand patterns across a city centre, and over a 24hr period. The image is taken from a time-sequenced video. Source: Citi Logik – see: www.citilogik.com

Using the same data, mayors would be able to implement policy measures to support businesses and the rejuvenation of high streets at a level of granularity that has never before been possible. For example, mayors could optimise public transport routes by assessing how people actually move around a city to spend money and ensuring routes and stops match citizens' needs. They could also target overseas advertising to tourists based on an analysis of where foreign visitors to the city come from and how much they spend. In this way, cities could focus their advertising in regions where the highest-paying tourists live.

Figure 3B gives an example of how electronic payments data from MasterCard has been used to reveal the home postcodes of customers who use a particular retail outlet in Leeds. Similar data analysis could be used to show the points of origin for consumers in a city.

Figure 3B: Points of origin (by postcode) of customers to specific retail outlet in Leeds and amount spent



3. **Managing congestion**

In September 2012, Vodafone worked with Citi Logik on a publicly funded project for Transport for London, collecting anonymised mobile phone location data across the capital to provide insights on journey time reliability. The data looked at how vehicles and pedestrians interacted with the Marylebone Road. Citi Logik collected data for eight weeks, aggregating a total of 1.2 billion anonymous journeys into, around and out of a pre-defined geographical area in London to give a picture of how people travel.

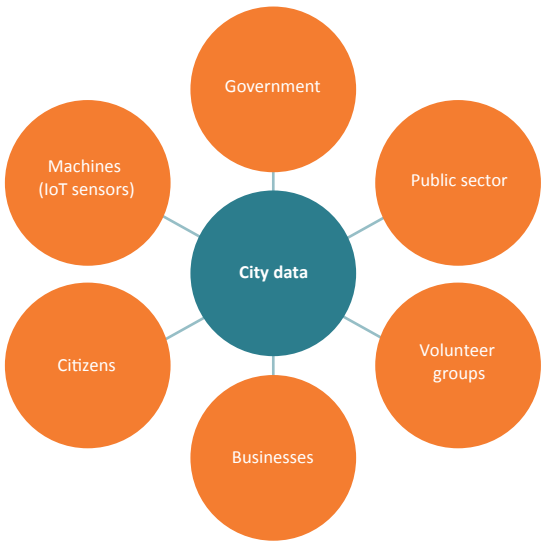
During the trial period, the company collected over 10 billion pieces of data and ran algorithms to create journey matrices of around 1.2 billion journeys. Anonymous phone location data was then turned into journeys and given a reliability score to help identify changes to the normal operation of the transport network. This was presented through a GIS visualisation in near real-time showing the anonymised and aggregated journey and pedestrian movement data to Transport for London. TfL used the data to inform the case to supplement the existing TfL roadside sensor network data with anonymised mobile network data.

Harnessing the power of city data

All these examples relate to a broader point: in any given city there are many different creators (or owners) and consumers of data. Just as businesses have information that could be valuable to local authorities, citizens may have information valuable to businesses, or volunteer groups. Businesses may have data that could be repurposed and used by other businesses. In short, city data lies in many places and could deliver value to different people.

The problem is that there is currently no mechanism to efficiently connect those with data to those that need it. Too often data remains in its existing silos, its value unrealised. So how can cities unleash the power of city data for the benefit of everyone? The answer is to create a City Data Marketplace.

Figure 3C: Creators and consumers of city data



The City Data Marketplace

A City Data Marketplace (CDM) would be an online marketplace that connected organisations or individuals that had useful data with those that wanted it. Similar to how sites like Upwork.com or TaskRabbit.com connect those offering their skills for hire with those that need jobs done, the City Data Marketplace would bring together creators and consumers of data. The site would have two types of listings:

Creators	Consumers
Individuals or organisations with datasets could advertise them on the site, specifying the quality, format, range and scope of the datasets, together with the price they would charge for providing them. Local authorities would use the same marketplace to list their open data.	Those needing data – whether a local authority, an ODA team, a business, charity or individual – could advertise their data *needs*. Creators could then see that request and publically bid to provide the data, specifying how they would source it, its quality and so on.

This marketplace solution would bring several benefits:

- **Increase availability of previously inaccessible datasets.** The marketplace would unlock potentially thousands of datasets that currently remain hidden within their organisations. Creating a mechanism to monetise data would provide an incentive for businesses to open up their data. Those requesting data could specify whether it was for private/internal use ("shared data"), or whether they wanted to release it as open data.
- **Increase innovation.** Instead of cities specifying the exact *data* they think they need, they could instead put a request on the CDM outlining the *problem* they want to solve. A variety of different individuals and organisations could then offer data that solves the problem in different ways. For example, the city may wish for data on traffic flow. Mobile network operators could offer data from analysing phone signals; an IoT provider could offer to install a sensor network; a volunteer group could offer to conduct street surveys.
- **Competitive pricing.** Some organisations could offer data for free (e.g. local authorities offering open data), others might charge, but the amount requested by consumers or listed by creators would be publically viewable, creating competition to find the best price for any particular type of data. As a result, data from different sources would be more accurately priced. (As a side benefit, if the data being offered by Internet of Things (IoT) providers was clearly superior, they could charge more, stimulating businesses to invest in IoT technologies.) Pricing should be made on the value of the outcomes the data can enable rather than on a per byte basis.
- **Review and feedback.** Similar to reviews of buyers and sellers on sites like eBay, the quality of datasets and data creators would be reviewed and ranked so that others could determine whether the data provided by each organisation was to the quality specified, encouraging better practice.
- **Potential new revenue stream for city authorities.** If city authorities (perhaps via the ODAs) hosted the marketplace, they could charge a small commission on any data sales conducted through the platform. This would help fund the

marketplace, and also subsidise the cost of ODA operations. This would not preclude offering open data for free.

- **Help spread best practice.** Currently there is no mechanism for local authorities or cities to see how other regions are using and paying for data to solve specific urban issues. Using the CDM, best practice could be shared as all purchases of data would be publicly viewable.
- **Highlight which open data sets cities should provide.** The UK currently measures its success on open data by the number of datasets it lists online. That is a poor measure. What matters is what the data is used to *achieve*. By offering open data alongside paid-for data from other sources, it would be more obvious to cities which data sets were of real value.

> "The UK currently measures its success on open data by the number of datasets it lists online. That is a poor measure"

- **Policy based on hard data in place of modelling.** By providing access to a wealth of information, cities would be able to design better initiatives and policies based on actual data rather than restricted estimates or models.

Clearly, the introduction of city data marketplaces must be accompanied by proper protections for citizens' data. The Information Commissioner's Office (ICO) has a detailed Anonymisation Code of Practice.[68] Any organisation wishing to sell or share their data via the Marketplace should be obliged to certify and provide evidence that they have met that code. Where public sector organisations within cities wish to use private sector data, they should share responsibility for assuring that the data they procure has met ICO regulations.

Summary

Through the creation of an ODA and a City Data Marketplace, mayors would have the data tools to use their powers effectively. They would be able to harness – and make available to others – data from public and private sector organisations to deliver economic growth; innovate to provide public sector reform and encourage citizen engagement in cities and city regions. In short, the data-driven model of smart cities offers a huge amount to city devolution, and will be pivotal to its success. Happily, the benefits are not one-sided. Indeed, as the next chapter will explain, city devolution offers much for the smart city agenda in return.

Recommendations

Encouraging external developers to make products with open data

Recommendation 5: Each city's Office of Data Analytics should take on responsibility for providing open data that covers the whole city. The open data ODAs provide should be a subset of the data that is used by the public sector itself. Providing open data at a city scale (rather than by each local authority) will help more developers find a viable business model, as there will be a larger potential customer base for their products and services.

Recognising the value and utility of private sector data

Recommendation 6: Cities should proactively seek to harness private sector data to deliver their policy priorities. For example, data from mobile phone networks and haulage companies

68 https://ico.org.uk/for-organisations/guide-to-data-protection/anonymisation/

could be used to improve road safety, while data from electronic payments companies could help increase economic activity, optimise public transport routes and enable better management of public services. Data should be priced according the value of the outcomes it can enable, rather than on a per byte basis.

Ensuring an effective public/private sector market for city data

Recommendation 7: Each city ODA should create its own City Data Marketplace. Cities should replace their open data portals with a city data marketplace where different creators and consumers of city data can buy, sell, request or freely exchange data. This would help unlock, correctly price, and stimulate demand for data held by citizens, businesses and other organisations both within and outside the public sector.

Guarding citizens' data privacy and ensuring the legal and ethical use of data

Recommendation 8: Those selling or offering data on the City Data Marketplace should be required to provide evidence that they comply with the Information Commissioner's Office (ICO) Anonymisation Code of Practice. Ensuring public confidence in cities' use of data will be vital for the success of data-driven initiatives. Where public sector organisations in a city choose to use private sector data, they should share responsibility for assuring that ICO regulations have been met.

4
Why Smart Cities Gain from City Devolution

Five questions have dominated much of the recent UK policy debate on smart cities:

1. Which smart technology solutions do cities actually need?
2. How can technology be implemented at a whole-city scale across different local authorities?
3. How will cities fund the upfront investment in those smart technologies?
4. What is the business case for investing in smart technologies?
5. How will cities ensure they install technology that is future-proof while also avoiding vendor lock-in?

Significantly, all are based on the assumption that smart cities are first and foremost about *technology*. In part, this can be explained by the fact that much of the smart city literature has been written by technology companies.[69] It is those companies, after all, that are investing millions of pounds to develop products and services that they hope will one day be installed in urban environments.

It may also be because the Government has conflated its goal to support UK cities in becoming smarter with its desire to help British technology companies develop and export smart city products and services.[70]

Both goals are undoubtedly important. Initial research conducted by the Department for Business Innovation and Skills (BIS) suggested that UK businesses could capture around 10% of the $408 billion global smart city market.[71] Yet by encouraging British companies to test their widgets in UK cities, the government has helped to reinforce the view that becoming 'smart' is primarily a question of cities putting in place the right technology. That is a mistake.

Smart city technologies represent a powerful and ever-growing set of cutting-edge tools that can benefit urban living. But tools by themselves are not enough. To be effective, they need to be accompanied by the political leadership to apply them to important challenges. They need to be implemented at a large enough scale that they can have impact across a whole city. They need the complementary human skills, administrative capacity and resources to use them to full effect. They need the sustainable funding to ensure they have lasting benefit.

Currently, these things are absent in most UK cities.

As a result, many UK smart city initiatives look like token projects. Implementing some smart sensors in parking bays or installing some smart street lighting in a single local authority may bring benefits, but are a far cry from the promise

69 As discussed in: http://www.theguardian.com/cities/2014/dec/17/truth-smart-city-destroy-democracy-urban-thinkers-buzzphrase

70 This may be reflective of the fact that, under the Coalition Government, smart city policy was largely led by the Department for Business, Innovation and Skills. The mixing of these two ideas is clear from the documentation for the Future Cities Demonstrator competition, which states that: "A successful demonstrator project will support UK-based businesses to develop new approaches and solutions that can be exported around the globe, and help UK cities to plan and build for the challenges of the future, improving their international competitiveness."

71 BIS, 'BIS Research Paper No. 136: The Smart City Market: Opportunities for the UK', October 2013, p.2. Key examples of policy measures in this area include the creation in 2013 of the Future Cities Catapult and George Osborne's Budget 2015 announcement of £40 million for research into the Internet of Things.

of what a smart city could be. The challenges listed in Chapter 1 – and the five questions at the start of this chapter – remain unresolved. So what is the solution?

Better together

Those who wish to see the UK lead the world in developing truly significant, impactful and sustainable smart cities have a direct interest in showing how smart initiatives can help deliver the objectives of city devolution (in all the ways described in Chapters 2 and 3). Why? Because city devolution removes many of the most significant obstacles to smart cities' success. Specifically, city devolution:

> "Cities are unlikely to be able to make effective use of the exponentially greater amounts of data that can be provided through Internet of Things technologies if they have not first developed the capability to use the data they already have"

- **Solves the problem of fragmentation.** Where smart city initiatives have struggled to achieve scale due to the fragmentation of local government, city devolution gives elected mayors powers and budgets to implement projects at a whole-city scale.[72] It is noteworthy that nearly all the cities regularly ranked highest on global smart city indices have a mayor (Barcelona, London, Hamburg, Berlin, Munich, Vienna, Geneva, Amsterdam, Paris, Nice, Copenhagen, Helsinki, Stockholm, Tel Aviv, Singapore, Seoul, Tokyo, Brisbane, New York, Los Angeles, Vancouver and Montreal).
- **Provides new funding streams for smart projects.** As part of the city devolution process, cities will be able to retain, and borrow against, any future increases in business rates.[73] If smart city initiatives can demonstrate that they are an integral part of helping local businesses to grow (recall the examples of NBAT in Chapter 2 and assessing street footfall in Chapter 3), cities will have a direct interest in funding those initiatives for the long term and will have a source of revenue to do so. More broadly, city devolution will help give UK cities more financial autonomy to invest in smart projects by addressing the fact that currently they control just 17% of their funding, as compared to an average of 55% across countries represented by the OECD.[74]
- **Enables smart initiatives to focus on important policy areas.** If other cities follow the deal struck with Manchester, city devolution will give mayors the authority to focus on (and apply smart initiatives to) important policy areas such as policing, fire, planning and transport that were previously either handled by individual public sector bodies or by central government.[75]
- **Provides a mechanism to put in place technology and data leadership roles.** City devolution stipulates that each city region must have an elected mayor. But the process of negotiating deals for each city is also an opportunity to discuss the other leadership roles required to enable a city to thrive. As Arup, an independent firm of designers, planners, engineers, consultants and technical specialists, has pointed out, UK city authorities already spend in the region of 6–8% on ICT – a figure comparable to the financial services sector – but lack the latter's significant IT governance structures, such as Chief Information Officers and Chief Technology Officers, to guide their choices.[76]

72 of the UK's 64 largest towns and cities fall under the remit of more than one local authority. 64 largest towns and cities defined as Primary Urban Areas (PUAs). See http://www.centreforcities.org/city-by-city/. London alone has 32 separate councils and the City of London.

73 HM Treasury, "Chancellor unveils 'devolution revolution'", 15 October 2015, available at: https://www.gov.uk/government/news/chancellor-unveils-devolution-revolution

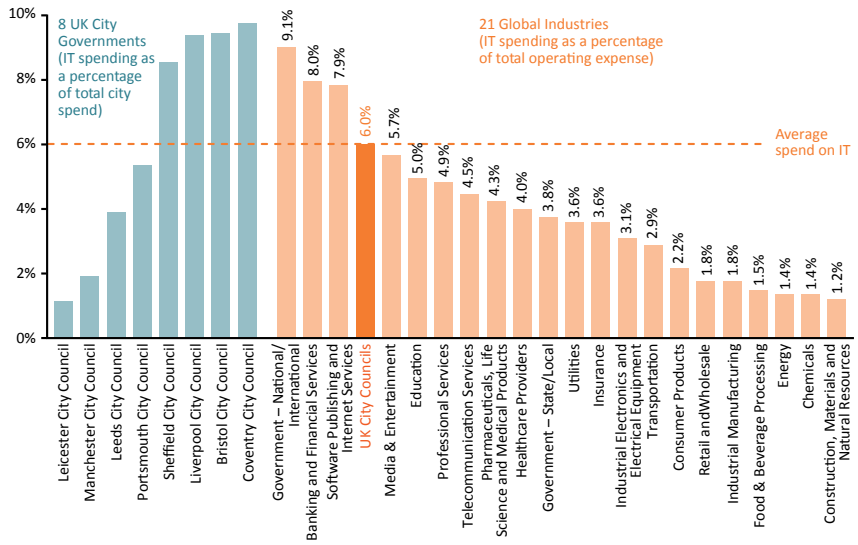
74 Centre for Cities, "Cities Outlook 2014", 27 January 2014, available at: http://www.centreforcities.org/wp-content/uploads/2014/01/14-01-27-Cities-Outlook-2014.pdf

75 See 'Greater Manchester Agreement' and 'Further devolution to the Greater Manchester Combined Authority and directly-elected Mayor', available at: https://www.gov.uk/government/publications/devolution-to-the-greater-manchester-combined-authority-and-transition-to-a-directly-elected-mayor

76 Arup, 'Delivering the Smart City', November 2014, p.14

A city CTO role will be vital to ensure that cities can make informed decisions about the smart city technology they really need, ensuring it is future-proof, value for money, and avoiding vendor lock-in.

Figure 4A: Analysis of public spending data from eight city councils (April 2011 to March 2014) by Spend Network, compared with IT spending as a percentage of total operating expense in 21 global industries



Source: Arup, 'Delivering the Smart City', November 2014, p.28.

- **Gives smart cities significance beyond the tech community.** The current Government has made city devolution one of the landmark policies of the 2015–2020 parliament. If smart city methods deliver – and are seen to deliver – on city devolution's objectives, it could transform them from a subject of niche interest to a Cabinet-level priority, with all the political backing that entails.

The story does not end with these direct benefits. By focusing first on data-driven smart initiatives to achieve the specific objectives of city devolution (i.e. by establishing ODAs and CDMs), cities will also put in place the foundation stones on which much more ambitious, technology-driven smart initiatives will depend.

One of the most important foundation stones will be **data skills.** Cities are unlikely to be able to make effective use of the exponentially greater amounts of data that can be provided through Internet of Things technologies if they have not first developed the capability to use the data they already have. A significant aspect of the Office of Data Analytics (ODA) model is that it is a catalyst for promoting the use of data analytics throughout all of a city region's public sector organisations. In New York, MODA's data is made available to staff working in other city agencies, enabling them to combine it with their own department's information to improve decision making.[77] MODA additionally provides training (in conjunction with local universities, such as the Centre for Urban Science and Progress) to help NYC agencies develop their own data analytics capability. In the

77 Such data sharing works on a strict principle of reciprocity: external agencies can access data collected by MODA on *the condition that the*y first share their own data.

case of the fire risk based inspection system (RBIS) outlined in Chapter 2, MODA helped the Fire Department set up and train its own data analytics team. That team has since taken on responsibility for developing the RBIS model. UK ODAs could perform a similar role working with local universities (as well as FE colleges, The Open University, the Open Data Institute and the Digital Economy, Transport and Future Cities Catapults) to address the lack of public sector data skills. It is particularly vital that senior public sector leaders receive training in how to use data to ensure data is established at the heart of each organisation's operations.

A second foundation stone is **political leadership**. Just as mayors will need an Office of Data Analytics, ODAs – and indeed many smart city projects – will benefit from having a mayor. Modern technology makes it much easier to access and analyse city data, but it may be hindered without the leadership to overcome cultural, legal and organisational barriers. As Stephen Goldsmith and Susan Crawford have written:

> *"In New York City, Michael Bloomberg took office as a mayor after long years of experience in the use of data, and he created a metrics-drive mayoralty. Agencies agreed to cooperate to set up his proposed data analytics center and other interagency data initiatives. Yet almost all of them soon asserted legal, technical, and operational obstacles to full participation. Budget experts also pushed back, worried about costs. Lawyers cited vast numbers of rules (most from the federal government) that prohibited sharing of data. Within each city agency, its chief information officer would explain why only he or she could manage the complex legacy databases of that unit. Despite his mandate, his commitment to data and a raft of first-rate appointees, Bloomberg would not have succeeded in making New York City a leader in data-driven government had he not pushed hard from the top for change."*[78]

In an interview with Policy Exchange for this report, MODA's first director Mike Flowers emphasised the same point, saying: "The most important thing I had in place was the Mayor. …Without mayoral support it's just impossible." As Chapter 2 established, UK cities share many of these same challenges and would benefit from having a mayor to overcome them.

Finally, focusing on data will put in place more **sustainable business models to fund smart city projects.** Some smart city technologies provide a clear return on investment. Replacing traditional streetlights with LED versions, for example, can reduce a council's energy bill by up to 80%, with a payback period of just five years.[79] Little stands in the way of cities installing such solutions. Yet few are so clear-cut, and it is widely acknowledged that UK cities have struggled to identify long term business cases for investing in smart city technologies.[80]

In the absence of a sustainable business model, many smart city initiatives find themselves reliant on EU and Innovate UK grants.[81] The risk of this is that smart initiatives will necessarily be short term (just two years after being awarded £24 million from Innovate UK, Glasgow announced it was already seeking sources of further funding for its smart city projects)[82] and directed towards ends dictated by the grant criteria rather than a frank assessment of what a specific city actually needs. Such grants are also unlikely to be scalable. Once a solution has been successfully trialled in one city, it is harder to justify additional pilots in others.[83] This is not only bad for cities; it is additionally unlikely to give UK technology businesses confidence that there is a sustainable domestic market for their smart city products.

78 Stephen Goldsmith & Susan Crawford, The *Responsive City,* Jossey-Bass, San Francisco, 2014, P.15

79 Green Investment Bank, Low *energy street lighting: making the switch,* February 2014.

80 See, for example, the Smart City Forum's briefing paper on financing and proving business cases. Available at: https://futurecities.catapult.org.uk/project-full-view/-/asset_publisher/oDS9tiXrD0wi/content/project-smart-cities-forum/?redirect=%2Fprojects. Efforts to remedy this have primarily focused on proving the technologies further, but have largely failed to recognise that cities' ability to make use of – and get value from – new technology is a crucial part of the business model.

81 See, for example, "Birmingham Smart Roadmap" and "Scottish Cities Alliance Smart City Strategy".

82 The Guardian, 'Glasgow: the making of a smart city', 21 April 2015, available at: http://www.theguardian.com/public-leaders-network/2015/apr/21/glasgow-the-making-of-a-smart-city

83 This point has previously been made by smart city expert Rick Robinson who has stated "research and innovation funds will not scale to support every city in the country", source: http://theurbantechnologist.com/2015/02/15/6-inconvenient-truths-about-smart-cities/#market

However, by focusing first on putting in place core *data* capacities (ODAs and City Data Marketplaces) to make city devolution a success, cities will improve the viability of three sources of smart city funding.

1. **Government and public sector.** A key investor in smart city technologies will be government, whether in the form of central government funding for cities, devolved city-wide budgets, or the budgets of local authorities themselves. Having spent time sourcing and analysing existing data from across an entire city through their Office of Data Analytics and City Data Marketplace, cities will be better able to spot gaps in their data and determine whether the cost of new technology that provides additional (or better, in terms of timeliness, quantity or quality) data is worth the benefits it will bring. In short, it will be much clearer whether or not there is a business case for investment.

   For technologies that do not provide data, but instead perform some other function, cities can use their ODA to target investment at areas of greatest need. To demonstrate the point, recall the case study from Chapter 3 which outlined how London could use data to reduce the number of cycling accidents and fatalities. If policy measures alone were not sufficient (e.g. banning HGVs at peak cycling times at dangerous junctions), the city could consider investing in a technology solution. For example, sensor-triggered flashing signs at lorry-cab level could warn large vehicles when a bicycle was next to them on the inside lane at a junction. Without using data in the ways described in Chapter 3, London would risk paying to install more of them than needed, or miss out the junctions where they would have the greatest impact. Having thoroughly analysed the real-time data on the routes used by cyclists and HGVs, however, they would be able to target the signs at the most dangerous locations, saving not just money but lives.

2. **Public/private sector collaboration.** The second funding model available to cities involves a hybrid of public and private sector money. Large technology firms such as Microsoft, IBM, Cisco, and Siemens have sought to work with local authorities to create smarter cities. In the UK, such partnerships include (among others) Glasgow's partnering with BT and Oracle, and Oxford City Council's partnership with Nominet.[84] Sharing the burden of developing and paying for technology solutions with private partners can drive better outcomes as cities benefit from businesses' resources, products and expertise. However there are number of challenges to make the model work effectively.

   Risks are posed if cities become too reliant on one company for specific capabilities or infrastructure. This was well demonstrated in Newcastle. In 2005, the city embedded speed-loops (sensors capable of detecting vehicles as they crossed and of ascertaining the type of vehicle and its speed) in a number of roads at considerable cost. Two software applications were commissioned, the first to collect the data and deliver it to a second, which was responsible for generating reports to be delivered to the city's Traffic team. Unfortunately the vendor delivering the first application went out of business and the vendor of the second application withdrew its support after a dispute. Consequently, the city was left with an expensive network no-one knew how to use, a problem that has only recently been addressed.[85]

84 See http://oxfordsmartcity.uk/cgi-bin/whitespace.pl

85 Newcastle Cloud Innovation Centre, Case *Study: The Newcastle City Council Speed Management Network.*

As local authorities use data to become better customers of technology – and develop their own data skills in-house, they will be better placed to make use of the expertise, resources and investment available from corporate partners.[86]

3. **Private sector.** Central and local government cannot pay for all smart city infrastructure. *Nor do they need to*. Instead, cities can create the right incentives for the private sector to invest themselves. This is arguably the most desirable funding model as it takes the financial risk away from taxpayers and avoids the pitfall of local authorities investing in technologies that are not futue-proof.

   One of the clearest examples of private sector investment in UK cities can be found in the networks that underpin the transfer of data. Companies such as Arqiva and SIGFOX are already installing low-power, ultra-narrowband networks for machine-to-machine communications (i.e. Internet of Things networks) in Birmingham, Bristol, Edinburgh, Glasgow, Leeds, Leicester, Liverpool, London, Manchester and Sheffield at their own financial risk.[87]

   The best way to encourage this kind of investment is to stimulate demand for data by local authorities, the public sector, businesses, charities and citizens – the purpose of the City Data Marketplace. That is because the demand will create an obvious business model for the private sector: companies can charge for access to the digital networks, providing a digital-network-as-a-service.

> "Cities can create the right environment and incentives for the private sector to invest themselves"

   The same logic applies to companies that offer technologies that provide data through smartphones, wearables and sensors. They, too, can charge to provide the *data* their products produce, rather than for the technology itself. Instead of being tied to one corporate partner, by creating a market for data cities can encourage an ecosystem of many different suppliers competing (or indeed, collaborating) to offer the best service.

Summary

It is clear that the cities of the future will make greater use of technology. But for technology to make a real difference, it requires the political leadership to apply it to important challenges. It needs to be implemented at a large enough scale to have impact across a whole city. It needs the complementary human skills, administrative capacity and resources to use it to full effect. It needs the sustainable funding to ensure it has lasting benefit. City devolution can provide all these things.

All that remains to be asked is, what technology do cities actually need?

Recommendations

Spreading data skills throughout the public sector

Recommendation 9: ODAs should collaborate with local university departments, FE colleges, the Open University, the Open Data Institute and the Digital Economy, Transport and Future Cities Catapults to source staff and to set up Data Analytics training courses to educate public sector workers – and

86 Similar to the challenge of using grant funding, cities also need make sure the technology their corporate partners wish to implement is something the city actually requires.

87 Arqiva, "We are building a UK network dedicated to the Internet of Things", 15 May 2014, available at: http://www.arqiva.com/news/press-releases/we-are-building-a-uk-network-dedicated-to-the-internet-of-things/

especially public sector leaders – about how to use data. In educating organisations about how to use their own and ODAs' information in their day-to-day and strategic responsibilities, ODAs can help stimulate demand for data, ensuring the data-driven smart city model grows in scale and effectiveness.

Putting in place key data and technology leadership roles

Recommendation 10: As part of the city devolution negotiations, cities should explain how they will put in place key leadership roles such as a Chief Analytics Officer and Chief Technology Officer. The Government regards an elected mayor as necessary to deliver city devolution, but it is not sufficient. Given the vital importance of data to the success of city devolution, a Chief Analytics Officer role should be put in place to lead the city's ODA. In due course, a Chief Technology Officer role will also be needed to ensure that cities can make informed decisions about the smart city technologies they really need, ensuring they are future-proof, value for money, and that they avoid vendor lock-in.

5
What Technology Will Cities Need?

With thousands of companies creating products and services as part of a global smart city market worth $408 billion, how will cities decide which technologies they actually need? Rightly, the answer to that question will be determined by each city based on local requirements. As Minister for Digital Industries, Ed Vaizey MP, said in an October 2015 speech on smart cities:

> *"…the Government is not going to try to impose a single approach on the UK's diverse places. Towns and cities, and companies and citizens, will make their choices to fit local priorities. The Government is committed to giving cities and regions the power to make their own decisions."*[88]

And yet, just as the success of smart city initiatives depends on having the foundation stones of political leadership and data analytics skills in place (see Chapters 2 and 3), some technology is more foundational than others, too.

Cities have long had to put in place underlying technical infrastructure such as roads and bridges, sewers and power grids on which services for transport, waste water management and electricity can be provided. In a smart city, the underlying technical infrastructure that matters is data networks. For whether smart initiatives are new or retrofitted, high-tech or low-tech, top-down or bottom-up, public sector- or private sector-led, all use data to detail or quantify aspects of city life so that better decisions can be made: by government, by businesses, by charities, by citizens and increasingly – with the advance of the Internet of Things (IoT) – by machines. Quite simply, smart cities are data-driven cities. Data networks will therefore be the vital utility and enabler for many other smart projects to work. So where will those networks come from?

Harnessing existing data networks

This report has already highlighted the need to make full use of existing city data. So, too, should cities ensure that they make full use of the networks that underpin them. These include those for:

- **Electronic payments.** Chapter 3 explained how data from electronic payments (i.e. credit and debit card companies) can be used to model citizens' movements and their commercial interactions within a city. With the adoption of contactless payments across different Transport for London services, electronic payments data is increasingly able to support the analysis and

88 DCMS and Ed Vaizey MP, "Speech: Smart Cities – UK opportunities and potential", 21 Oct 2015, available at: https://www.gov.uk/government/speeches/smart-cities-uk-opportunities-and-potential

modelling of passenger movements as well – a benefit that should be borne in mind as other city regions consider their options for harmonising ticketing systems across different modes of transport.

> "Quite simply, smart cities are data-driven cities. Data networks will therefore be the vital enabler for many other smart projects to work"

Payments networks can also support the reform of public services. The London Borough of Brent is the first local authority in the UK to go entirely cashless. The council offers a range of MasterCard prepaid products to support all payments out of the council and collects all inward payments using an electronic payment gateway. With all financial transactions now electronic, the local authority is able to analyse in detail how residents interact with its services so they can be improved. The change has already delivered significant process and administrative savings, reduced fraud, and helped to release staff from back office work to focus on front line care.[89]

- **Mobile phones.** The smartphone should be understood as one of the core pieces of technical architecture in a smart city, in two ways. First, as Chapter 3 explained, aggregated and anonymised mobile phone data can be applied to help cities achieve important outcomes, such as reducing congestion, supporting business growth, and improving cyclists' safety. Second, smartphone applications provide a route for two-way communication between government and citizens. The NGO MySociety led the way in developing websites and apps that put power in the hands of citizens to report problems to their local authority, such as graffiti or potholes. Many more local authorities now use these tools, placing the smartphone at the centre of many citizens' relationship with local government services.

Cities should seek to leverage existing networks like these for three main reasons.

First, they represent a **timeless platform.** City authorities do not have to fund these existing platforms or ensure they are future-proof. In the case of electronic payment networks, cities can benefit from technology paid for and updated by the banking and payments industries. Similarly, mobile phone operators invest in updating their own networks, while the vast majority of citizens pay for their own smartphones and periodically upgrade their handsets. As a result, there is no point at which the platform as a whole becomes out of date – it gradually evolves according to the latest developments in technology.

Second, they **transcend public sector boundaries.** Chapter 2 noted the challenges of joining up data across public sector silos, and particularly building up a city-wide picture of any particular issue when data is divided across a patchwork of local authorities. A key benefit of electronic payments and mobile phone networks is that they transcend those boundaries, enabling real-time data to be sourced from across the whole city. Even better than that, they can show how people move into and *between* different cities. This could be of huge help to initiatives that aim to span or join up several cities. A key example would be providing data to inform the work of Transport for the North, the organisation that brings together local authorities and combined authorities across the North of England to work on the integration of transport networks.[90]

89 MasterCard, "London Borough of Brent – The road to becoming a Cashless Council", 27 August 2015.

90 http://www.transportforthenorth.com/about.html

Third, it provides a mechanism for **citizens to opt-out.** While there are many keen advocates of the greater use of technology in smart cities, others worry that using sensors to quantify every aspect of urban life means they will become digital panopticons or a manifestation of the Big Brother state.[91] Yet if the smartphone is used as a key platform for the smart city, those who do not wish to be part of the smart city system would be empowered to opt out; to quite literally 'log out' of the smart city. It may mean forgoing certain incentives, but the choice will be theirs to make. This would be similar to how, on an Android phone, a person can switch off the location setting (i.e. deactivate GPS), giving them more privacy, but meaning that they forego useful tools such as Google Maps directions. For those who worry about citizen privacy, providing such an opt-out mechanism may help allay concerns about the development of smart cities.

The next platform: Internet of Things

The major technological development that looks set to positively transform cities is the Internet of Things (IoT) – connected devices that can send data to each other and to people. The UK telecommunications regulator Ofcom estimates that there are already 40 million IoT connected devices in the UK; the figure is expected to grow eightfold by 2022.[92] Pilot schemes in cities such as Milton Keynes have shown that much can be done with low-powered, IoT-connected sensors that measure things like moisture, temperature or whether a parking space is occupied.

> "Given that cities are fundamentally made up of people, addressing some urban issues will inevitably require changing people's behaviour"

Recognising the importance of IoT for smart cities, in July 2015 the Government launched an Internet of Things competition for cities in which the Department for Culture, Media and Sport (DCMS) announced it would "invest up to £10 million in a single collaborative R&D project to demonstrate the capability of the Internet of Things (IoT) in a city region."[93] This is part of a wider £40 million government investment in IoT announced in the March 2015 budget. The competition aims to show how the large-scale deployment of IoT can benefit citizens by offering environmental improvements, economic opportunities, and more efficient and effective delivery of services such as transport, healthcare and energy.[94]

IoT devices can help in a variety of ways that will benefit cities.

1. **Influencing citizen behaviour.** Much of the smart city narrative focuses on optimising *things*: traffic lights, buildings and signage. But given that cities are fundamentally made up of people, addressing some urban issues will inevitably require changing *people's* behaviour. IoT devices can help do just that, as is expected to be the case with the roll out of household smart energy meters. Smart meters could enable "demand side response". Put simply: by providing live pricing information, they could encourage consumers to switch off appliances during peak periods and instead use them when the price of energy is low.

   Evidence also suggests that households cut the amount of electricity and gas they consume when their energy use is compared to that of more energy efficient neighbours. According to a 2013 study by Policy Exchange,

91 See, for example: The Guardian, 'Smart cities: are you willing to trade privacy for efficiency?', 4 April 2014, available at: http://www.theguardian.com/news/2014/apr/04/if-smart-cities-dont-think-about-privacy-citizens-will-refuse-to-accept-change-says-cisco-chief

92 http://www.theguardian.com/technology/2015/feb/09/internet-of-things-security-risks-appliances-passwords

93 https://interact.innovateuk.org/-/internet-of-things-cities-demonstrator

94 https://connect.innovateuk.org/documents/1524978/1866952/Internet%20of%20Things%20cities%20demonstrator%20-%20competition%20guidance

households could reduce their gas and electricity bills by as much as £70 a year if they were able to see how their consumption compared to the energy bills of similar households.[95] Energy companies such as Ovo, E.ON and British Gas offer various versions of the service, mainly enabling people to see comparative figures for similar homes. IoT-enabled smart meters could make this process even more effective by providing hyperlocal, real-time data.

2. **Optimising use of public services and city infrastructure.** Milton Keynes has successfully installed IoT sensors into public rubbish bins, enabling waste collection routes to be optimised to collect only those bins that actually need emptying. Given that waste management is one of the most significant line items in local authority expenditure, this could offer significant savings. The city has also applied 300 connected parking sensors to direct drivers to available parking spaces via an app, optimising the use of the city's parking spaces. Sensors can likewise be applied to infrastructure such as railway lines, traffic lights, and bridges to provide early warnings of problems that can be addressed before they cause disruption and become expensive to resolve.

3. **Automation.** Finally, some applications of IoT sensors will work best when humans are removed from the decision-making process altogether, using machine-to-machine communication to enable objects to respond to their environment. A key example would be using temperature, light and moisture sensors to enable office buildings to dynamically monitor and adjust themselves to save energy. Returning to the example of smart meters, as households buy an increasing number of IoT-enabled home devices, it will be possible for appliances to continuously monitor live energy prices and switch *themselves* on when it is most cost-effective to do so.

For all these applications to work, cities will need networks to enable IoT devices to communicate. It makes little sense for each individual smart project to have its own network – doing so raises the barriers to trying new smart initiatives. Having ubiquitous networks that can be used by public sector organisations, private businesses and citizens will therefore be a prerequisite of a very substantial number of smart city projects, just as phone networks are vital to mobile phone users. As Chapter 4 outlined, cities can help create the right conditions for the private sector to install them by stimulating demand from businesses, charities and citizens for the data those networks can provide.

Summary

This report is agnostic on the specific technology applications that any particular city or city region should implement. Decisions need to be made locally based on each area's needs. However, whether it is regarded as the currency, fuel or oil of the modern world, data is of fundamental importance to both smart cities and city devolution. As such, data networks will be the vital infrastructure of future cities. Cities should leverage existing data networks to full advantage, but also ensure they have the right incentives in place for the private sector to connect the next generation of IoT devices on which many smart initiatives will depend.

95 Policy Exchange, 'Smarter, Greener, Cheaper, Joining up domestic energy efficiency policy', January 2013.

Recommendations

Recognising the importance of data networks

Recommendation 11: As cities consider the technology they need to enable smart initiatives to thrive, they should recognise that data networks are the vital underlying infrastructure. Cities should seek to maximise their use of existing networks (e.g. those for mobile phones and electronic payments) and work to incentivise the private sector to create new Internet of Things networks by stimulating demand for data.

6
Final Thoughts

Policymakers should take away five key messages from this report:

First, the Government's policy programmes on city devolution and smart cities offer considerable benefits to UK cities. But in isolation they face serious challenges that could lead them to fail. City devolution equips mayors with extensive new powers. But those powers will achieve little without the tools to use them effectively; tools which smart cities can provide. Smart cities, meanwhile, offer a suite of remarkable technologies that can improve cities. But those technologies will struggle to have a significant impact without the right people, powers, resources and skills; things that city devolution can put in place. There is therefore a huge opportunity to bring the two agendas together; each provides what the other needs.

Second, data will be fundamental to the success of both city devolution and smart cites. Yet most UK cities lack the ability to join up, analyse and act upon the vast quantity of data they already have. They should address this by emulating the New York Mayor's Office of Data Analytics: putting in place a core team with the capabilities, technical resources, skills and leadership to combine, map and interrogate data from across multiple local authorities and public sector organisations. By establishing an Office of Data Analytics, cities will also improve the quality and reliability of their open data, encouraging those outside the government to make more innovative use of public sector information.

Third, cities should create a mechanism to harness – and make available to others – city data held by citizens, businesses and other organisations. They can do this by creating a City Data Marketplace where different creators and consumers of city data can buy, sell, request or freely exchange data. Such datasets could provide the ability to improve areas such as road safety, business growth, traffic management and tourism without having to invest in new infrastructure.

Fourth, having learned to use existing data, cities will be better able to make informed decisions on – and identify the business case for – investing in more advanced smart city technologies. By stimulating demand for data, they can also incentivise the private sector to take on the financial risk of installing smart city infrastructure, as companies can charge for data, rather than the technology that provides it. To have a long term impact, smart cities must be based on a sustainable business model.

Fifth, the most important technical infrastructure in a smart city is the networks that enable the transfer of data between people, organisations and devices. Cities should make full use of existing networks (such as those provided by electronic payments companies and mobile phone operators) and encourage the implementation of Internet of Things networks on which many other smart projects can be built.

Above all, the report has highlighted that the Government is right to place cities at the centre its policy programme for 2015–2020. With over 80% of the population living in urban areas, much rides on ensuring their future success. City devolution offers to give local areas the powers they require to address local needs and play to local strengths. Smart cities offer to bring cutting-edge technology to help cities cope with growing pressure on public services, transport, infrastructure and energy. But cities will need both things.

Brains *and* brawn.
Powers *and* the tools to use them.
Smart devolution.

Appendix

Interview with Mike Flowers, Founding Director of New York City Mayor's Office of Data Analytics

On 16 October 2015, MODA's founding director, Mike Flowers (now based at Enigma Technologies) visited Policy Exchange to record an interview with Eddie Copeland about his experiences of applying data analytics to urban environments. Below is an abridged transcript of that interview.

EC: Mike Flowers, welcome back to Policy Exchange. You've been here in London talking about the work that you did in New York City where you were the Founding Director of the Mayor's Office of Data Analytics under Mayor Bloomberg. How did that role come about?

MF: Well, in 2009 the city's population was continuing to grow. At the same time our budgetary resources were not increasing, so Mayor Bloomberg was basically pursuing any approach that would allow us to wring more efficiency and effectiveness from city service delivery mechanisms, and one of those assets that he believed was under-leveraged was our data.

EC: Were the approaches that he brought to cities very similar to what he'd been doing in the corporate world?

MF: Yes, absolutely. If you look at the Bloomberg Terminal, it's simply a synthesis of different information streams for the purposes of making decisions in the financial markets. All we did was… copy that approach for government services.

EC: The model that you pioneered in New York was very much about using existing city data. Can you give an example of an area you applied that approach to?

MF: Certainly… what proved to be one of our most valuable sources of information as a predictor of where we should be allocating our resources was property tax records. Property tax records have been public for decades. They've only been really collected for the transactional purpose of recording that somebody actually paid off their tax obligations on a piece of real estate, but… that same information – whether you paid or not – proved quite valuable in terms of predicting where a fire might occur or other bad things that would require emergency response.

EC: What was the process of taking that data and using it to predict something useful?

MF: The actual process itself was… quite rudimentary and straightforward. It was simply a matter of putting it into a csv in Microsoft Excel as a data point among many data points that we looked at when cross-tabbed with a particular outcome we were trying to prevent or incentivise. So that's a long-winded way of saying we just put it all in one place and took a look at its relevance.

EC: We often hear about 'smart cities' that are investing heavily in big, new technology to be part of a smart urban future; you're talking about a relatively low-tech approach. Was that a deliberate choice?

MF: Leaving aside the term "smart cities" and what that even means… it was deliberate but it was a deliberate choice that was imposed on us. If I had gone to the Budget Office and asked them for a significant outlay of taxpayer money for a technology that we hadn't even shown a need for yet, they would have laughed at me, and appropriately so. In fact I would have been happy, as a taxpayer, that they would have refused that kind of request.

So really we took a… "bootstrap method"… What that allowed us to do was a couple of things:

First it allowed us to show that there's a lot of untapped value in existing [data] assets… Second it also allowed us to actually frame the questions we needed to ask of whatever technology we would ultimately buy. So instead of going in and relying on the vendors to tell us what we needed or didn't need, we ourselves were able to shape and drive that conversation and make sure that we got the best value for our dollar.

> "If I had gone to the Budget Office and asked them for a significant outlay of taxpayer money for a technology that we hadn't even shown a need for yet, they would have laughed at me, and appropriately so"

EC: Cities round the world are struggling with establishing the business case for investing in smart initiatives. How did you approach deciding where there was going to be a return on investment?

MF: We took a proof of concept approach that would turn into a pilot, which was all a self-contained experiment… on whether or not it made sense to do things the way we were proposing to do them. And once that proved successful the next step… was to impose that across the enterprise for the entire agency or multiple agencies.

And at that point we had basically proved "Yes, this makes sense, this is something we can do, it's not going to be disruptive to the organisation, and in fact [it] will provide real value." And it was under those parameters that we would then go out and allocate funds to do that enterprise expansion.

And that's when you're talking about a technology spend. You don't do a technology spend until you're ready to really implement it in a way where it's going to get used right away… It doesn't mean it's to the exclusion of technology. It's just technology should not be driving the conversation.

EC: If it's not about a big tech solution, what did you have in place in City Hall to make sense of that information?

MF: The most important thing I had in place was the Mayor. None of this ever could have happened without Bloomberg's backing… Without mayoral support it's just impossible. So that's the first thing you need.

And once you have that, then you just have to go out and listen to the agencies on the ground and just ask them: "What are your problems? What are your challenges?" A lot of people think that if they implement key performance indicators as part of a performance management programme for their various cities… that's the answer, and it's really not. All those things do is create an external scrutiny on the agency for them to fix whatever problem is perceived to exist, without providing them any assistance.

Whereas the approach we took was going the next step, which is, "OK, we've identified this problem or this challenge… here's how we're going to go about fixing it. So I'm here to help you with an information product that will help you solve the problem that people are yelling at you to fix."

EC: So spending time with front-line workers was vital?

MF: That was the primary source of work for my office. The only times we ever did work that was top-down actually ended up being pretty useless, in the sense that we would come up with a solution and then go to the agencies without really understanding that problem… We'd get there and they'd go: "No, that's not our problem. *This* is our problem." So we would toss whatever solution we'd come up with and come up with a solution that actually worked for them.

> "I think waiting to get the data in the right place and in the right way is just an eternal wait. You're never really going to get fully there, and why would you even want to? So the most important thing… is just to get going, pick a problem; solve it"

EC: How did you get over the technical challenge of bringing together different data sets which may not be easy to compare?

MF: We took it on a matter-by-matter basis, rather than trying to come up with a universal ontology [i.e. open standards for data]… More important to me was simply extracting the information that was locked in the silos, getting it into a singularly accessible place, accessible by all, and then, on a project-by-project basis, we would synthesise these ontologies. Most of the time for New York City that just meant synthesising locations, like getting them all on a map in the same place.

EC: I understand there are several different ways of recording location in New York, is that right?

MF: Quite a few! Latitude and longitude, post code, building number, housing number, utility account number. There's dozens of ways in New York City… of saying "Where am I?". But the answer to that question invariably involves [asking] "Why do you want to know?" …That was why I felt it didn't make any sense to spend a lot of iron on hammering out a universal identifier first. …I think rather a problem-driven approach served us quite well.

That said, there is a technology piece to that. [But] you don't really know what you need from them [the technology providers] until you go in and start answering these questions.

EC: So, not trying to implement open standards for data across the piece, but focusing on specific outcomes that matter?

MF: Right.

EC: And MODA had the expertise to do that data crunching in order to compare different datasets?

MF: That was our primary expertise… To be fair, I personally didn't have that skill set and still don't, but what I was looking for were data scientists… If you're any good as a data scientist you have the ability to pull that information together and join it however it needs to be joined for the task in hand. The agencies themselves had the subject matter expertise so they would tell us specifically what they wanted out of it and they would tell us the anthropology behind the dataset so we would do the right interpretation.

EC: I know you're a fan of the London; you've mentioned its similarities to New York. If you were standing in front of the Mayor of London and trying to give some advice on where to start, what would you say?

MF: What I would say, I guess, would be… find a problem that's really upsetting from a resource allocation standpoint or an efficiency standpoint, to both you as a government actor as well as the citizenry that you are obligated to serve, and fix it.

Whatever that problem is, figure out a way to leverage your data assets to optimise the return on GLA resources and then that will drive an iterative discovery process that will tell you how you want to craft your office. I think waiting to get the data in the right place and in the right way is just an eternal wait. You're never really going to get fully there, and why would you even want to? So the most important thing… is just to get going, pick a problem; solve it.

EC: And the experience from New York suggests that that doesn't have to be expensive, doesn't require big tech solutions, doesn't necessarily even require a big team. Is that right?

MF: Yes, you're absolutely correct. No, it did not cost a ton of money. It was the cost of my salary and the salary of a couple of analysts, and we leveraged existing data sources…. Our big data tool – at least at the very beginning – was Microsoft Excel. It's pretty much the same business tools that are available on pretty much everybody's desk at this point.

EC: In New York you now have Mayor Bill de Blasio, who has a very different set of priorities to his predecessor. Will MODA endure? How do you see the model evolving?

MF: There was a successor appointed to my position, my old office still exists, the data infrastructure and the analytics infrastructure that we put in place still exists…

The agencies themselves are leveraging the foundation that we laid in the Bloomberg administration… The Parks Department just announced their first Analytics Director as an example. The Department of Health continues to be very robust in terms of data. So it's scaling and it's… taking on a life of its own within the agencies, which is exactly what I wanted.

…One of Mayor de Blasio's first initiatives was the expansion of Universal Pre-Kindergarten, certainly a laudable goal… In order to get there, they had to leverage the information infrastructure that we had pulled together in the Bloomberg administration to roll it out in a way that was successful. So proving my point that it [the MODA model] is policy agnostic, but also proving that once you light the fuse it will take on its own life within the civil service if you execute it correctly.

EC: You're now based at Enigma Technologies, which provides analytics infrastructure and advice to a whole variety of organisations including cities. What advice would you give UK cities on where they should begin with harnessing their data?

MF: I think they should look at what they've already got before they start picking up the phone and calling vendors.

Every locality generates data. It's impossible at this point not to be generating data because you probably have a utility system that generates water, because you've got to bill them somehow.

You have an ambulance service. You have a fire service. You have a police service. You have businesses that are licensed in your town. You've got roads that people travel, etc. etc. etc.

You actually have in those a tremendous untapped resource that you can look to to solve the problems that you're facing in terms of meeting your obligations to deliver those services.

So I'd tell cities the first step is to look inward. The answers really are already there. They just need to decide to take that first step.

UK smart city case studies

Glasgow

Organisations: Glasgow City Council leads the delivery of its smart city plans. The council is supported by other public sector bodies like Police Scotland and NHS Greater Glasgow and Clyde, as well as by housing and energy providers, universities and Scottish Enterprise.

Funding: In January 2013, Glasgow City Council won the Technology Strategy Board (now Innovate UK) Future City Demonstrator competition, receiving a £24 million grant to take forward its proposed smart city programme.

Purpose: Glasgow's 2011 future city consultation set out to resolve long term challenges around health, life expectancy, the environment and energy; and it recognised that technology could help to improve quality of life, deliver economic benefit and reduce the carbon footprint of the city. The council's future strategy also had to prepare to host the 2014 Commonwealth Games as thousands of visitors flocked to the city. Technology was seen as a way to better manage city transport and to ensure public safety.

Projects: Through the *Future City Glasgow* programme, Glasgow City Council has set out make the city "smarter, safer and more sustainable". One of its first projects saw the integration of the city's traffic lights and CCTV systems under one roof – the Glasgow Operations Centre. Initially helping to prioritise safety and security during the Commonwealth Games, the capabilities of the operations centre now allow officials to plan for flows of people and traffic, as well as coordinating with local police to prevent crime.

More recently, a city data hub, built in partnership with Microsoft, was unveiled to the public. The hub openly shares nearly 400 datasets; including information as varied as healthcare statistics and footfall records, to the location of bike racks and driving test centres. Drawn from over 50 organisations, the data hub is providing Glasgow's public sector with information that can be used to alter local service provision. As the data is all non-personal, it is open for reuse by developers, businesses and the wider public. The council has even created an app for Glasgow's cyclists to track and map their cycling routes through the city which can be uploaded to the data hub and used by the council to plan future cycle lanes.

Glasgow is also pioneering in Internet of Things technologies. A network of newly installed street lights are able to alter levels of illumination as people come and go. The lights automatically report faults with the LED bulbs and the masts are fitted with air and noise pollution sensors. Below the road, sensors embedded into the tarmac monitor traffic and communicate with traffic lights controlling the flow of vehicles around the city.

Milton Keynes

Organisations: Milton Keynes Council is central to the smart initiatives around the city and has actively formed key partnerships with academic institutions and businesses to bring in expertise to help it create a smarter city. Through MK:Smart, the council is supporting The Open University and other consortium partners (like BT, E.ON, Anglian Water, HR Wallingford, Fronesys and the University of Bedfordshire) to demonstrate the potential of a number of smart technologies. In another partnership, the UK Autodrive consortium, Milton Keynes Council is collaborating with a number of companies and academic institutions in a trial of autonomous vehicles.

Funding: In January 2015, the MK:Smart partnership secured £8 million in grant funding through the Higher Education Funding Council for England's Catalyst Fund. The grant has been match funded by its other partners to bring the total funding to £16 million. In December 2014, the UK Autodrive consortium secured £9 million in grant funding from Innovate UK, matched by £10 million from commercial partners, to trial driverless cars.

Purpose: With Milton Keynes ranking as one of the fastest growing UK cities, it is turning to technology to fuel sustainable economic growth, meet carbon reduction targets and to cope with the expected extra demand on transport and utilities infrastructure.

Projects: Faced with increased demand on city services the MK:Smart project hopes to innovate in the delivery of transport, energy and water to the city. Pivotal to these efforts has been the creation of the MK Data Hub – a data analytics infrastructure. Designed by partners The Open University and BT, and hosted at the University of Bedfordshire, the data hub collates large volumes of city data and is capable of performing complex analytics. Data currently being utilised includes demographics and public services data, energy systems and satellite data as well as real-time data from a network of new sensors. Insights drawn from analysing the data will be used to model the deployment of city resources and provide new approaches to managing demand. Importantly, the MK Data Hub will include open APIs that ensure interoperability with other city systems and allow private developers to create applications.

To complement the data hub, a city-wide Internet of Things network designed to collect data from sensors and connected devices has been installed through a project supported by the Digital Catapult. It is hoped that the real-time data collected will be able to be used by the council to improve services, but the network is also open to innovation by SMEs wanting to trial their own devices or sensors. The primary connectivity infrastructure is a Low Power Wide Area Network installed by BT. Working in partnership with other companies, the project already has two pilots underway: Three-hundred connected parking sensors are directing drivers to available parking spaces via an app. Connected recycling bins around the city are allowing waste disposal providers to better manage the waste collection process.

Milton Keynes is leading the UK in a trial of autonomous vehicles, including two-person pods that drive in pedestrian areas using only cameras and sensors for navigation; a project being run in partnership with the Transport Systems Catapult, Oxford University and RDM (an automotive SME). A further partnership with Ford, Jaguar Land Rover, Tata, Arup and others is expanding the trial over the next 3 years to include saloon cars on the city's roads using autonomous technologies. The potential for autonomous vehicles to reduce congestion, carbon emissions and demand for new roads will help the city meet environmental targets, and it is hoped might encourage private investment into the city.

Bristol

Organisations: With high level leadership from Mayor George Ferguson, Bristol City Council has championed a smart city approach in Bristol. The council leads the *Connecting Bristol* programme designed to ensure the city benefits from a thriving digital economy. The council's Futures Unit has helped to set up the *Bristol is Open* project too: a joint venture run with the University of Bristol.

Funding: In March 2012 Bristol City Council was awarded £11.3 million by the Department for Culture, Media and Sport under the "Super-Connected Cities" scheme. Part of this funding (£5.3 million) has been spent investing in the connectivity infrastructure that underpins the *Bristol is Open* project. Other investment into *Bristol is Open* has been secured from European funding schemes, from academic research grants as well as from private companies (Chinese firm NEC has signed an MoU to support the initiative). In January 2013, the council was awarded a further £3 million by Innovate UK through the Future Cities Demonstrator competition. Additionally, the council has secured over £1 million in grant funding through various European Commission schemes to take forward green technology projects that help to reduce carbon emissions. Most recently, Bristol City Council as part of the VENTURER consortium was awarded £5 million by Innovate UK as one of four city areas chosen to trial driverless cars.

Purpose: As the European Green Capital for 2015, Bristol has had a strong focus on using technology to help it meet its environmental goals, including a commitment to reduce the city's carbon dioxide emissions by 40% by 2020. The Mayor's vision of Bristol as a city of experimentation has also been central to the development of an Internet of Things demonstrator.

Projects: Supported by the Department for Energy and Climate Change, Bristol's first smart city report targeted projects which would improve the city's green credentials. With funding secured through a number of European Commission grants, the city was able to conduct trials of smart metering and smart grids, encourage greener ICT use among enterprises and invest in the city's electric vehicle infrastructure.

With help from the Super-Connected Cities award, the *Bristol is Open* project is underpinned by £5.3m of investment into three new high speed connectivity networks across Bristol. A newly laid fibre network will offer download speeds of up to a terabit per second; a wireless network will utilise '6G' technology; and a mesh network installed on 1,500 lampposts will facilitate communication between low-power devices and sensors. Together, the three networks provide a comprehensive canopy across the city and a 'City Operating System' will be used to manage traffic across the most efficient path. Due to be completed in late 2015, initially the networks will be opened up to selected businesses and researchers as an opportunity to trial IoT applications at city scale. Access to Bristol University's supercomputer will also be made available. With a large investment into the network infrastructure, the council's hope is that the data that is collected can be used in the future urban planning of the city and to improve public services, for instance mapping traffic flows and in monitoring vulnerable people. Importantly, all the data collected over the network will be published via the city's open data portal for use by developers and the public.

Bristol has also championed a grassroots approach to smart cities, supporting community organisations, individual champions and engaged citizens. The idea of the city as a "living lab" has flourished, with local organisations like the *Knowle West Media*

Centre and *Watershed* supported in delivering technology projects designed by and for the city's inhabitants. For instance, the "Playable City Award" funds technology initiatives that best combine art and culture. The 2013 winning entry, "Hello Lampost", allowed street furniture (including lampposts and post boxes) to communicate with willing participants via text – asking questions about their surroundings and recording the information to play back to others. Recognised as a hub for innovation, Bristol has also recently been chosen as one of four UK sites to trial autonomous vehicles. Bristol City Council along with other consortium partners will be responsible for ensuring the vehicles safely navigate public roads in early 2016.

Two key policy programmes lie at the heart of the Government's work to make the UK's cities better, more vibrant and sustainable places to live, work and visit. The first is city devolution; the second is smart cities.

Each has the potential to bring many benefits to the UK's urban areas. Each faces significant policy barriers to achieving its aims. The central argument of this report is that a successful city strategy requires both; each provides what the other needs. City devolution equips mayors with extensive new powers. But those powers will fail to have impact without the tools to use them effectively; tools which smart cities can provide. Smart cities, meanwhile, offer a suite of remarkable technologies that can improve cities. But those technologies will deliver little without the right people, powers, resources and skills; things that city devolution can put in place.

The report explains how by linking the two programmes together – and recognising that both require mastering the use of data – the Government's aspiration for city devolution to deliver regional economic growth and local public sector reform can be realised. It argues that policymakers must therefore look to equip the UK's cities with both brains and brawn. Powers and the tools to use them. Smart devolution.

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