



Department
for Business
Innovation & Skills

SMART CITIES:

Background paper

OCTOBER 2013

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1. Introduction

This paper, which forms part of the Information Economy theme of the Industrial Strategy, considers the challenges which cities face, the role which Smart City concepts play, the opportunities for business and the role of Government in strengthening UK capability and helping firms to exploit their expertise in global markets.

2. Summary and Conclusions

In this report we set out the enormous challenges facing cities, the size of the opportunity afforded by the focus being given, worldwide, to addressing those challenges by transforming city infrastructures and city systems, and the key actions needed to seize those opportunities.

Arup estimates that the global market for smart urban systems for transport, energy, healthcare, water and waste will amount to around \$400 Billion pa. by 2020¹. On the basis of the UK's share of OECD tradable services, it conservatively estimates that the UK should aim to secure 10% of this global market, worth \$40 Billion pa.

Growth opportunities lie, no less, at home through smarter approaches to transport management, healthcare and energy. On the back of better connectivity and better access to public information, we can manage cities more effectively, anticipate and solve problems more cost effectively, and raise the economic prospects and the quality of life in every British town and city. In so doing, the UK can strengthen its position as a global hub of expertise at a time when cities throughout the world are seeking innovative solutions to the challenges of urbanization.

As the Section on current policies and programmes makes clear, there is a considerable amount of work already underway to develop the UK's capacity to deliver smart concepts. However, global competition is increasing steadily and cities outside the UK are becoming the focus for this competition. We set out the innovative approaches of a sample of global cities in Section 8, and more fully in the report on case studies provided by Arup, which accompanies this document².

We consider future success depends on three main elements:

- **An innovative and demanding customer in the form of British town halls:** Innovation by local authorities requires vision and leadership; a real focus on the key challenges they face, such as congestion, care in an ageing society, and economic growth; an openness to new approaches/new business models; and the ability to manage risk. A key barrier to progress is that, under current financial conditions, town halls are focused on maintaining statutory services and the internal bar to innovation is

¹ BIS Research Paper No.136, "The Smart City Market: Opportunities for the UK" October 2013

² BIS Research Paper No. 135 "International Case Studies on Smart Cities" October 2013

set quite high. The actions we have proposed therefore relate to lowering the bar and fostering user driven innovation by:

- providing cities with greater autonomy to achieve the outcomes which meet their own particular needs through City Deals;
 - helping UK cities to develop a vision for city regeneration by promoting a better understanding of developments in global cities at the forefront of the smart city agenda (e.g. Chicago, Boston, Barcelona and Stockholm);
 - helping cities, through the Future Cities Catapult, to understand the opportunities offered by city-integration, to test and prove the business case, to collaborate with business and academia to innovate solutions, and to tackle the barriers – such as procurement rules or lack of investment, which stop new solutions going to scale.
- **Continuous development of capability:** This constitutes a wide range of activities, including:
 - Establishing a Smart Cities Forum, comprising representatives from cities, business, OGDs and the research base, to develop a shared perspective, identify barriers to progress and advise Ministers on strategic priorities, global developments/opportunities, and to co-ordinate Government policies in areas related to smart cities;
 - Maintaining UK thought leadership through the Foresight Programme;
 - Supporting research in areas germane to the smart city concept, including the Internet of Things, secure technologies, intelligent search, supercomputing, and systems modelling and analysis;
 - Promoting new applications of technology through the Technology Strategy Board (TSB) and through the use of SBRI in the smart city context, to capitalize on the innovative capacity of SMEs;
 - Promoting supply chain initiatives in complex utility service systems;
 - Developing interoperable standards to facilitate systems integration;
 - Analysing the impact on communities of making Government data (Trading Funds as well as local data) freely available in two cities and training officials in its effective release.
- **Staying abreast of global developments and seizing opportunities:**
 - Working with international standards bodies to ensure that UK solutions are marketable worldwide;
 - Working constructively with the EU Commission and member states on proposals to develop a European capability, and securing UK participation in future programmes;
 - Delivering, via UKTI, a strategic approach to promoting and exploiting UK capability overseas; and
 - Supporting UK participation in leading global city networks, such as C40 and the City Protocol Society.
 - Establishing the Future Cities Catapult, a global centre of excellence on urban innovation, which will help cities, academia and business collaborate to produce exportable innovations, help grow the market share of UK business and reinforce the UK's world-class cluster.

We consider this to be a comprehensive approach and one which reflects the views and aspirations of both our city and business stakeholders.

3. Challenges Faced by Cities and the Need for Smarter Approaches

Our starting point is the wide range of challenges that are driving change in UK cities:

- economic restructuring, combined with the economic downturn, has raised levels of unemployment, particularly among young people, and so economic growth and building a resilience to further change is a key priority for city authorities;
- the urban infrastructure has grown piecemeal and rising urban populations are putting pressure on housing and transport;
- concerns about climate change, and the fact that 80% of the UK population live in cities, inevitably means that cities have a key role in improving energy efficiency and reducing carbon emissions, while promoting energy resilience in terms of security of supply and price;
- the paradigm shift towards online entertainment and online retail/consumer services is beginning to change the nature of the High Street;
- an ageing population is placing an increasing burden on adult social care, to the point where it is absorbing an ever-increasing proportion of local authority budgets;
- at the same time, the pressures on public finances have seen local authority budgets reduce, on average, by an estimated 12-15% in real terms over the past three years³, with many reporting 20-30% cuts.
- notwithstanding recent flexibility accorded to Local Authorities in relation to Council Tax and Business Rates, grants from Government Departments are still the main source of local authority funding, especially for cities, and local authorities consider this to limit their ability to provide integrated responses to the challenges they face.

The scale of the challenges is forcing cities to rethink their strategies and to innovate in order to maintain service levels, in particular:

- outsourcing services using outcomes based contracts;
- service integration, both back office and increasingly front line services;
- online service delivery;

³ “Local government’s role in promoting economic growth” by Prof Tony Travers, commissioned by the LGA

- releasing data to enable new services to develop and citizens to make informed decisions e.g. providing real-time information on traffic to assist citizens in planning journeys; and
- reducing demand on services, for example, promoting independent living allows older people to live much longer in their own communities with less statutory support.

However, the complexity and the pace of change, combined with the need for integrated and systemic solutions, are presenting a major challenge to local authorities who, traditionally, have developed responses in a “siloed” fashion. This requires organisational change as well as deploying innovative technology and the Technology Strategy Board (TSB) has sought to provide support to cities, developing more integrated approaches, by providing a platform for UK businesses to develop the solutions they require. In 2012, it launched a competition, to invite cities to develop feasibility studies, in preparation for a competition to fund a large scale Future Cities Demonstrator. The choice of Glasgow as host for the demonstrator was announced in January 2013. This process highlighted the difficulties which many local authorities are facing.

It is not simply a question of the capability within local authorities to develop smart concepts. There are significant barriers to adoption/uptake, which we discuss in Section 7. Furthermore, with the support of Arup, we have developed a broader perspective of how a number of leading global cities have responded to their own challenges, providing us with evidence of good practice, which is summarised in Section 8, and published separately as supporting evidence.⁴

We now turn to the concept of smart cities and then the scale and nature of the market opportunity.

⁴ BIS Research Paper No. 135 “International Case Studies on Smart Cities” October 2013

4. What is a “Smart City”?

As consumers of private goods and services we have been empowered by the Web and, as citizens, we expect the same quality from our public services. In turn, public authorities are seeking to reduce costs and raise performance by adopting similar approaches in the delivery of public services.

However, the concept of a Smart City goes way beyond the transactional relationships between citizen and service provider. It is essentially enabling and encouraging the citizen to become a more active and participative member of the community, for example, providing feedback on the quality of services or the state of roads and the built environment, adopting a more sustainable and healthy lifestyle, volunteering for social activities or supporting minority groups. Furthermore, citizens need employment and “Smart Cities” are often attractive locations to live, work and visit.

But the concept is not static: there is no absolute definition of a smart city, no end point, but rather a process, or series of steps, by which cities become more “liveable” and resilient and, hence, able to respond quicker to new challenges. Thus, a Smart City should enable every citizen to engage with all the services on offer, public as well as private, in a way best suited to his or her needs. It brings together hard infrastructure, social capital including local skills and community institutions, and (digital) technologies to fuel sustainable economic development and provide an attractive environment for all.

There are five key aspects to smarter approaches, which are strongly information driven:

- a modern digital infrastructure, combined with a secure but open access approach to public re-useable data, which enables citizens to access the information they need, when they need it;
- a recognition that service delivery is improved by being citizen centric: this involves placing the citizen’s needs at the forefront, sharing management information to provide a coherent service, rather than operating in a multiplicity of service silos (for example, sharing changes of address more effectively), and offering internet service delivery where possible (at a fraction of the face to face cost);
- an intelligent physical infrastructure (“smart” systems or the Internet of Things), to enable service providers to use the full range of data both to manage service delivery on a daily basis and to inform strategic investment in the city/community (for example, gathering and analysing data on whether public transport is adequate to cope with rush hour peaks);
- an openness to learn from others and experiment with new approaches and new business models; and
- transparency of outcomes/performance, for example, city service dashboards to enable citizens to compare and challenge performance, establishment by establishment, and borough by borough.

But cities and firms we have consulted agree that the key attribute for a Smart City – the sixth and critical criterion - is that the leadership has a clear and consistent vision of what the future city offers its people, with a commitment to deliver the necessary change. It is a vision which has been developed in consultation with its citizens, creating an attractive environment for business across the city, so that the quality of life of all its citizens is enhanced by anticipating their needs and meeting them, such that firms and people embrace the vision and want to locate and live there.

We have sought to capture the concept of a Smart City in the diagram below, by showing the shift from the delivery of specific services (Figure 1A) to a citizen centric approach (Figure 1B). This involves closer interaction between citizen and service providers - a genuine two-way process, which is more personalised; a much stronger recognition of, and response to, the strategic interdependencies of different services; and the drive for innovation – particularly digital delivery - emanating from the Leader, Mayor or Chief Executive. The diagram borrows heavily from the lessons from international case studies summarised in Section 8.

Figure 1A. Traditional Model of Service Delivery

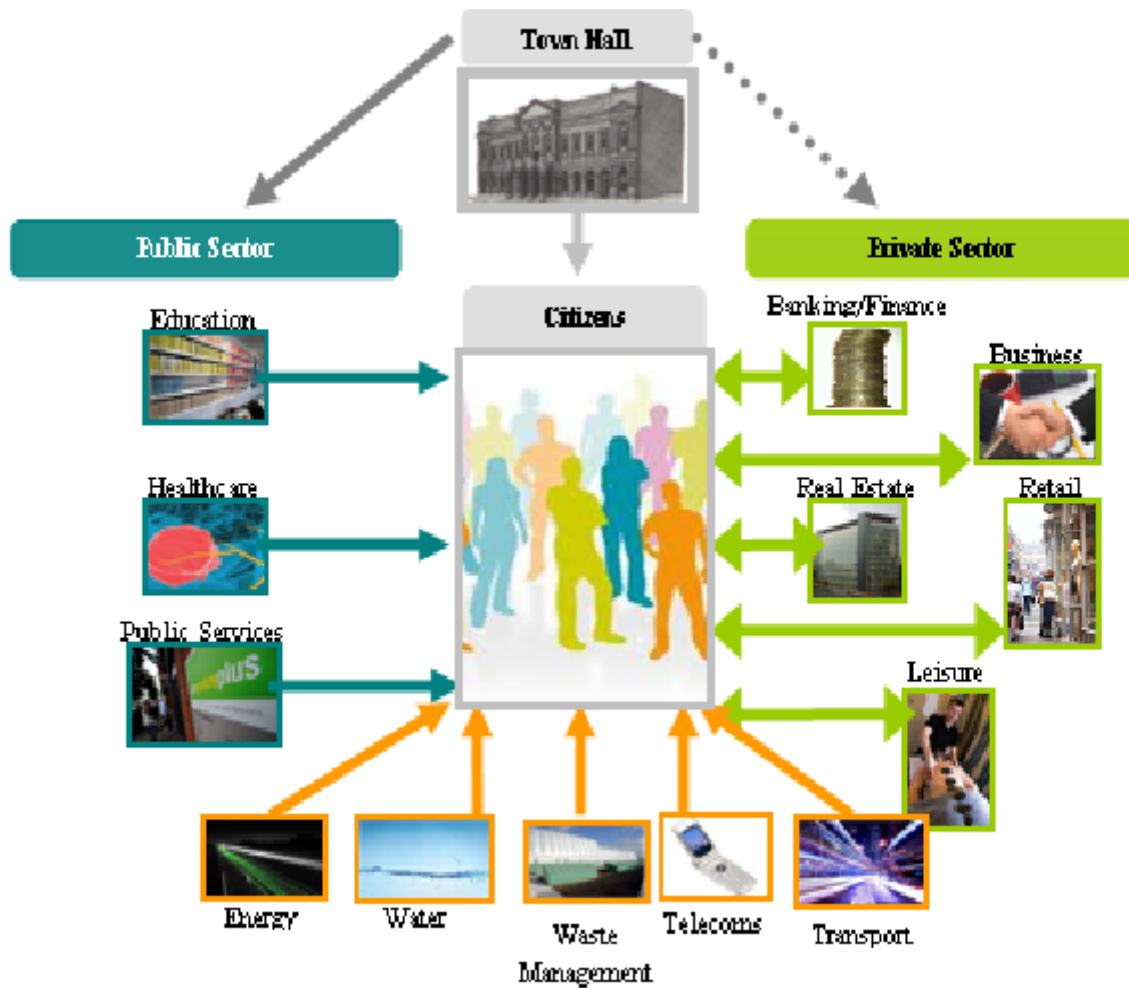
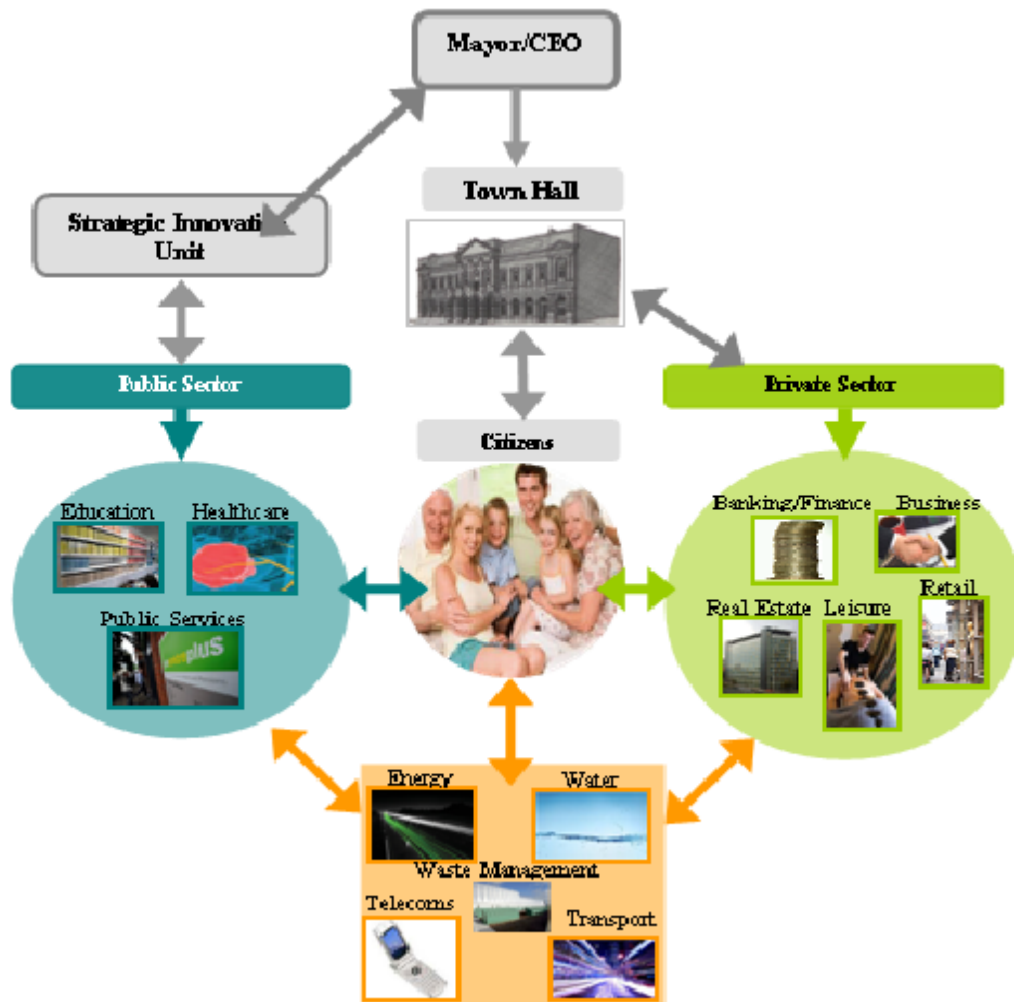


Figure 1B. Smart City Model



5. Smart Cities as the Fulcrum of Growth

Urbanisation and economic development are two sides of the same coin. In 1800 just 2% of the world's population was urbanised. By 1900 this had risen to 13%; in 2000 the figure had reached 47%; and in 2008 it passed 50%. On current trends it is estimated to be 60% in 2030; 70% or even 75% in 2050; and virtually all this growth will take place in the developing world as it emulates Western Europe and North America.

According to the McKinsey Global Institute's extensive study of global cities⁵, 80% of global GDP is generated in cities with 50% in the 380 major cities of the developed world and 10% in the largest 220 cities of the developing world. In 2025, these top 600 cities will still be generating 60% of the growth in GDP but their membership will have shifted East with an estimated 100 new cities entering the rankings from China alone, where the urban population is expected to rise by 200 million, to over 800 million. Some 235 million households earning more than \$20,000 pa (at Purchasing Power Parity rates i.e. adjusting for the different cost of living) will live in the emerging economy cities, compared to 210 million in developed region cities. This growth of a global urban middle class, with correspondingly high expectations of public services and the quality of the urban infrastructure and environment, will have a profound impact on the market for smart city services. For example, in January 2013, the Chinese Government announced a Green Building Action Plan that sets a national target for 20% of all new buildings to be green by 2015.

But it would be a mistake to think that smart urban development is purely a developing world phenomenon. There is a growing recognition among city leaders in the developed economies that smarter approaches are needed to address the challenges which confront society, to improve the efficiency of public service delivery, the sustainability of the urban environment, and the quality of life in our cities. Furthermore, these cities are using smart concepts to enhance their locational competitive advantage, promoting their sustainable and smart credentials to attract new business and talent.

As part of our evidence base, we commissioned Arup to examine the evolving nature of public service delivery in urban environments, and the design and management of the five main service utilities, with a view to identifying opportunities for UK firms in the value chain:

⁵ http://www.mckinsey.com/insights/mgi/research/urbanization/urban_world

- Intelligent transport systems: Traffic monitoring and management, congestion management, road user charging, emergency response, public information systems, smart parking, and integrated traffic light management;
- Assisted or Independent Living: telehealth and telecare products and systems, and digital participation services;
- Water Management: Water system upgrades, consumption monitoring, wastewater treatment, environmental safety systems, and flood management;
- Smart grids or energy networks: Demand management, electronic vehicle support, energy efficiency program, and renewable energy integration; and
- Waste management: Waste collection modelling and consistent supply to energy generation.

The global market for smart city technology and associated products and services is difficult to define and harder to forecast, with research organisations using different forecasting approaches. The research has shown that valuations of smart technology markets can vary significantly between sources. For example, in transport, research organisation Markets and Markets predicts the smart transport market to reach \$156.3 billion in 2020, while Pike Research predicts a mere \$5.55 billion. Such differences in estimates arise from differences in the scope of economic activities included by the different organisations.

The Arup study makes use of estimates that go beyond technology and include the wider set of economic activities, such as design, consultancy, engineering, installation etc. which the investment in smart technologies will bring. These are more relevant and appropriate for UK industry and the elements of the value chain where the UK has a competitive advantage. It considers a variety of forecasts from different sources, arriving at a composite figure for the market in 2020. Estimates forecast the smart energy technologies market (including smart grid) will reach \$220 billion worldwide by 2020⁶, whilst other sources estimate smart transport to be \$156 billion⁷, and smart water to be \$22 billion⁸ globally by 2020. Additionally, Arup conservatively estimates both smart waste and assisted living technology markets to reach \$5 billion⁹ each globally. These figures, in aggregate, reach an estimated annual \$408 billion worldwide by 2020¹⁰.

⁶ Zpryme

⁷ Markets & Markets

⁸ Frost & Sullivan

⁹ Arup estimates based on interviews with industry experts

¹⁰ Aggregate estimate based on multiple sources

If UK business were to take 10% of the market - according to the OECD, the UK's share of exports of business services is around 12% - it would be worth \$40 billion p.a.

However, the value of the smart systems which underpin smart cities and communities is just one element of a potentially much larger market. In its report on "Reinventing the City to Combat Climate Change"¹¹, Booz Allen estimated that, in real terms, global investment in urban ICT and telecommunications over the next 30 years will amount to over \$30 Trillion. Furthermore, there is a much wider set of professional services which are brought into play, as new business models require careful financial appraisal, legal and contracting skills, as well as finance itself, property services and marketing.

Even more importantly, the creation of smart communities acts as a "honey pot", as new firms and young professionals are drawn to the area and create growth dynamics based on new clusters of expertise, which spill over into property refurbishment, leisure and entertainment. This, in turn, provides employment opportunities for a much wider segment of the population. Thus, it is not only major cities, such as Boston, Chicago, Stockholm, Barcelona, Copenhagen, Amsterdam, Berlin, London and Manchester which have benefitted from giving a focus to "smart". Smaller communities, such as Friedrichshafen, Aarhus, Santander, Paredes, Peterborough and Bristol are attracting start ups and generating growth on the back of a firm commitment to Smart City concepts.

As noted above, the multifaceted nature of the challenges and the wide range of factors determining success make it difficult to predict policy outcomes. However, it is clear that an increasing number of cities around the world consider that innovation in the urban environment and in the delivery of public services are central to wider economic growth. The McKinsey and Booz Allen reports point to the scale of this investment, particularly in the medium size range of cities worldwide. We cannot be complacent: there is growing competition as the global market expands. Foreign firms involved in developing Smart Cities, exemplified in our global case studies and many others, provide a strong competitive threat to UK business. We therefore examine current policies and the actions which need to be taken to strengthen UK capability, in order to stay at the forefront.

¹¹ Reinventing the City to Combat Climate Change, Booz &Co Autumn 2010

6. Government Policies and Programmes

As we indicated in the Summary, there are a wide range of Government policies and programmes which are relevant to developing the UK's capability. They can be grouped in five main areas:

- encouraging and empowering city authorities to develop the vision and leadership to provide solutions to their own problems;
- promoting open data and the capacity of organisations to improve access to open data, to share and to use it, including the development of open standards;
- programmes to develop underpinning technologies and to demonstrate their efficacy;
- Departmental programmes to encourage the adoption of new approaches and technologies, to transform both the service systems and consumer behaviour;
- participating actively in EU programmes.

A sixth key area of policy is helping UK firms to exploit their capabilities in global markets.

City Deals to Empower City Authorities:

The Coalition Government is committed to unlocking the full potential of our cities, seeing powerful, innovative places that are able to shape their destinies and fulfil their potential. In December 2011 the Government published *Unlocking Growth in Cities*, launching a programme of City Deals. Each deal is bespoke, reflecting the different needs of individual places; each deal, however, aims to:

- give cities the powers and tools they need to drive local growth;
- unlock projects or initiatives that will boost local economies; and
- deliver a step-change in governance.

The Cities Policy Unit leads on this work across Government. To date it has concluded deals with the eight largest cities in England outside London, creating devolved powers and new and innovative ways of doing things that will unlock growth. In February 2013, Government invited a further 20 cities and their wider areas to negotiate for the devolution of the specific powers, resources and responsibilities required to deliver their locally-

determined economic priorities.

Promoting Open Data and its Use:

In recent years the Government has promoted Open Data as a means of holding Government to account, improving the quality of public services and creating new opportunities for business. The Open Data White Paper¹² of June 2012 set out its vision of a truly transparent society and its aims for public bodies to achieve a 5 Star level of transparency. Key elements of the Government's Data Strategy include the establishment of the:

- **Public Sector Transparency Board:** The Board was set up by the Prime Minister in June 2010 and is chaired by the Minister for the Cabinet Office. The Board is a mix of public sector data specialists and data experts which drives the Government's transparency agenda, making that agenda a core part of all government business.
- **Public Data Group**¹³ The PDG consists of 4 data-rich organisations - Ordnance Survey, Met Office, Land Registry and Companies House - working together to support growth in the UK economy through:
 - improving access to public data;
 - driving best practice both within and beyond its member organisations; and
 - developing new activities.
- **Open Data Institute**¹⁴: The ODI was officially launched at its offices in Shoreditch in December 2012 with the support of £2 million pa for five years from the Technology Strategy Board and \$750,000 from the Omidyar Network. The Institute, founded by Sir Tim Berners-Lee and Prof Nigel Shadbolt, is an independent, non-profit, limited by guarantee company. Its remit is to catalyse an open data culture that has economic, environmental and social benefits. It offers training programmes to raise the capacity of UK organisations to capitalise on Open Data.

An important element of the Government's strategy towards Open Data is to experiment and develop applications, which meet user needs. Cabinet Office is proposing to work with one or two cities to create a local ecology around open data services – decentralising innovation by encouraging start-up communities and beyond to experiment and innovate with open data, engaging with the wider city and leading to the creation of new products and services. Cities in the rest of the UK and beyond could then see what works (or not) and have a good point to start their own open data innovation work.

Key here would be establishing the right environment, allowing for experimentation not just on pooled public data but also linked social media data and commercial data as well. The idea, loosely, would be to release as much data as possible, with the right support

¹² Open Data White Paper Unleashing the Potential. Cm 8353

¹³ <https://www.gov.uk/public-data-group>

¹⁴ <http://www.theodi.org/>

infrastructure and legal environment, and see what a community of developers produce. This will hopefully produce scalable results that users in those cities and beyond can engage with.

But the concept of Smart Cities involves data from a wide range of sources and systems. This requires a focus on protocols for data sharing and data flowing from construction assets. It also involves the development of standards to accelerate the implementation of smart city solutions through providing the necessary guidance, frameworks, specifications, protocols and vocabulary to create a common understanding of the issues, manage the risks effectively and optimise communication across the city. These are set out more fully in Annex A.

Developing and Demonstrating New Technology:

Foresight:

The Government has recently announced the establishment of a Foresight Project on the Future of Cities¹⁵, sponsored by the Minister for Cities, Greg Clark MP. The project, which will run over two years, will develop a programme of research to inform policy development in relevant Departments and contribute to sharing ideas and approaches to developing future cities.

The Foresight project will focus on how UK cities can best contribute to economic growth over the coming decade, but placing this within a wider view of prosperity which recognises that good quality of life, wellbeing, equity and social inclusion will all be vitally important for cities and their citizens. Also, recognising that cities compete with each other, both nationally and internationally, to attract private finance and investment, the project will consider the opportunities for UK cities within a national and global 'system of cities'.

The project will also assess future challenges to UK cities, many of which will be common to other countries, for example ensuring resilience to increasing threats due to climate change. It will also be a valuable opportunity to learn lessons from cities overseas which have different levels of development and are at different periods in their 'lifecycle'.

Overall, the project will aim to identify opportunities for Britain to add value to the international debate on cities. In this way, the project will give the UK a platform to address issues affecting UK cities in the longer term, as well as contribute to the debate on the future of cities globally.

Research:

Other elements of the Information Economy Strategy theme have highlighted the role of research in developing the UK's capability in future developments. While there is not a Smart Cities research programme as such, there are a number of activities funded by RCUK which underpin the concept, in particular:

¹⁵ <http://www.bis.gov.uk/foresight/our-work/projects/current-projects/future-of-cities>

- **e-infrastructure Leadership Council**¹⁶: Following the Tildesley Report¹⁷ “A strategic vision for the UK e-infrastructure” in 2011, the government has developed the UK e-infrastructure Leadership Council for collaborative academic and industrial pre-competitive research and development.
- **Digital Economy Programme**: A key focus of the RCUK Digital Economy Theme has been to look at how, in sustainable societies of the future, people will be able to make informed sustainable choices. There are three elements of particular relevance to smart cities:

(i) Urban Prototyping (UP) London. In contrast to many of the established views on smart cities, UP London asks a fundamental question about cities – how can digital technologies, art, and design serve as new tools to be used by citizens to improve their urban environment? What does this mean for citizen empowerment and engagement with their cities? UP London seeks to understand the real barriers to entry for creating start-ups in this space.

(ii) Digital City Exchange (DCE)¹⁸ is a £5.9M five-year multi-disciplinary research programme led by Professor David Gann at Imperial College. This seeks to find innovative solutions to optimise the use and planning of cities in order to revolutionise the way in which our cities work and the way in which people live in them. It started in October 2011.

(iii) Liveable Cities¹⁹ is a five-year EPSRC Programme Grant led by Professor Chris Rogers (Birmingham University). Liveable Cities aims to develop a method of designing and engineering UK cities, which are low in carbon consumption, resource secure, and which maximise citizen wellbeing. This will be achieved via the development of a City Analysis Methodology (CAM) that will measure how cities operate and perform in terms of their people, environment and governance, taking account of wellbeing and resource security.

Economic Regeneration: As we have seen in the international case studies²⁰, there is an important role for universities to play in support of the city in which they are located. This is, not only providing graduates for the knowledge intensive jobs which a smart city creates, or creating edgy and attractive districts, and access to expertise, but also using their evaluation skills to provide advice to the city authorities on the impact of different approaches to tackling specific challenges. For example, in developing its strategy towards smart cities, Birmingham City Council appointed a Smart City Commission which included representatives from the city’s universities, and Birmingham University’s Institute for Advanced Studies is funding a comparative study of regeneration with its American twin, Chicago. The strength of the links between “town and gown” is likely to be increasingly important in the drive towards Smart Cities.

¹⁶ <https://www.gov.uk/government/policy-advisory-groups/122>

¹⁷ <https://www.gov.uk/government/publications/e-infrastructure-strategy-roadmap-for-development-of-advanced-computing-data-and-networks>

¹⁸ www.imperial.ac.uk/dce

¹⁹ EP/J017698/1 <http://liveablecities.org.uk/>

²⁰ op cit Arup report.

Technology Strategy Board (TSB):

Over a period of years the TSB has invested heavily in the elements which comprise a Smart City. For example, it has been working since 2008 with Department of Health in developing assisted living technologies and, more recently, in deploying these technologies in the Whole System Demonstrator and DALLAS (Digital Assisted Living Lifestyles at Scale). Its Knowledge Transfer Networks have also focussed on smart applications of technology for transport and energy and it has recently announced Catapults in relation to Transport Systems and the Connected Digital Economy, which will contribute significantly to UK capability in this field.

The TSB has developed its strategy towards future cities even further by focussing on the need for cities and business to move from optimising performance, within the individual elements or service systems, to the more integrated and systemic approach, outlined in this report. To promulgate this thinking it has launched two initiatives to support UK businesses to innovate the products and services required to meet the needs of cities:

- a Future Cities Demonstrator Programme
- a Future Cities Catapult

Future Cities Demonstrator Programme: This is a £33m TSB project which will demonstrate at scale, and in use, the additional value of integrating city systems. Glasgow City Council won the funding through an open competition that saw 30 UK cities develop innovative proposals to dramatically improve their performance. Glasgow City leaders intend to make the city more successful by providing new integrated services across health, transport, energy and public safety, and enabling UK businesses to test new solutions that can be replicated around the globe. Bristol, London and Peterborough were also shortlisted and, in April 2013, each was awarded £3m to deliver an element of their original proposals. The data from these projects will be directly fed into the Future Cities Laboratory (see below). It is expected that the four Future Cities Demonstrator projects will work closely together to maximise collaboration and learning. It is also expected that the Glasgow Demonstrator project will work with the TSB DALLAS project, already underway in Glasgow, to create synergies and maximise the potential benefit of each project.

The Future Cities Catapult: will be a global centre of excellence on urban innovation, a place where businesses, universities and city-administrations come together to develop solutions to the future needs of cities.

It will help UK businesses create the products and services that cities across the world need; and, whilst recognising that every city is unique, it will look for those solutions that are transferable and scalable.

The Catapult will focus particularly on the challenge of urban integration: how cities can take a more joined-up approach to the way they plan and operate.

It will be based in a central London Urban Innovation Centre, a space in which business, academia, investors, innovators and cities can collaborate, get expert support and develop and test their ideas. This will also be a place where innovative SMEs can work

closely on projects with the larger infrastructure companies that are their route to market.

The core capabilities of the Future Cities Catapult will include:

- The Cities-Lab, a world-leading facility where live data feeds, advanced modelling, simulation, analysis and visualisation can be brought together to support new, commercialisable solutions to city challenges. This will allow cities, SMEs and businesses to plug in their data and ideas, test the viability of new business models and come up with improved solutions, all for a fraction of the cost they would have to otherwise spend.
- A futures and best practice programme, which will highlight what “great” will look like for truly sustainable and future-proofed cities. This will include showcasing best practice, drawing out the factors of success, highlighting coming risks and opportunities and making these available to decision makers and innovators to help them understand the opportunity.
- Workstreams to overcome the barriers to city-integration, such as uneven procurement rules, inadequate templates for shared IP and lack of financing. Deploying integrated city systems depends as much on financial innovation as it does on technological innovation. New financial models are required to convert potential revenue streams into effective infrastructure investment. The UK’s financial sector is already strong in this area, but is keen to develop new solutions with cities engaged in projects based in the Catapult.

The Energy Technology Institute (ETI)

The ETI is a public private research partnership, involving six companies whose funding of projects is matched by the public sector, in particular EPSRC. Its Smart Systems and Heat (SSH) Programme aims to design and test a commercially viable Smart Energy System in the UK, facilitating improved heat management and low carbon energy services across the country. This involves the investigation of mass-market consumer behaviour and requirements to understand the likely future demand for heat and energy usage. The design methodology phase of the programme is under way, and work has begun on Enabling Component Technologies (identifying gaps in the potential range of smart systems technologies), Energy System Design Tool Development (assessing the impact of a Smart Energy System in a geographical area), Data Management and Architecture (fulfilling information and service requirements of a smart energy system), Value Management and Delivery (identifying how value can be delivered across the value chain) and Consumer Behaviour Study (insight into consumer requirements for heat and energy both now and in the future). ETI has also started engagement work with local authorities, who will provide the demonstration locations for the second phase of the programme: a mass-market field trial of up to 10,000 homes to ensure any system design can be replicated geographically across the UK.

Departmental Programmes to Transform Service Systems

Department of Health (DH): The Department has been exploring with the Technology Strategy Board, for a number of years, how technology might be applied more effectively to monitor patients' health and well-being. There are 15.4 million people living in England with at least one long term condition; expectations are that this will increase to around 18 million over the next 20 years²¹. The Department estimates that, without innovation, the annual cost of the NHS will increase by £4bn p.a. in five years. To understand better the costs, benefits and barriers to the adoption of new approaches, using telecare and telehealth, DH launched the Whole System Demonstrator programme (WSD) in May 2008. The WSD is the largest randomised control trial of telecare and telehealth in the world, involving over 6,000 people across three sites in England and 238 GP practices. It showed that, when targeted and used correctly, telehealth could reduce unplanned admissions by 20%, elective admissions by 14%, tariff costs by 8%, bed days by 14%, and A&E admissions by 15%. More strikingly, it demonstrated the potential for a 45% reduction in mortality.

Notwithstanding the findings from WSD, take up in England has been slow: figures from Jan 2011 showed around 5,000 telehealth users and 1.5m pieces of telecare in use to date. However, taking the learning from WSD, DH launched the **3millionlives** initiative (www.3millionlives.co.uk) in January 2012. It is a unique collaboration between Government, industry, NHS, social care and others, to improve the lives of three million people with long term conditions by 2017, through the better use of telehealth and telecare, embedding greater dignity and independence across the NHS and the healthcare industry. The initiative is underpinned by the idea of service integration to provide flexibility and more appropriate care.

Seven pathfinder sites²², with a minimum of 10,000 patients in each, have been identified to contract with providers using a new business model to meet the needs of people with long term conditions in their areas. As a result, an additional 100,000 people, with long term conditions, will benefit from telehealth in 2013. This is telehealth at scale and a significant step forward in the **3millionlives** initiative.

Case Study

²¹ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/136422/White-Paper-Caring-for-our-future-reforming-care-and-support-PDF-1580K.pdf

²² Worcestershire Health and Social Care Partnership
Kernow CCG and NHS Cornwall and Isles of Scilly PCT,
NHS Kent and Medway and Kent County Council (8 Participating CCG's and Kent Community Health Trust)
North Yorkshire & York and Humber cluster
NHS South Yorkshire & Bassetlaw
North West Pathfinder
Camden CCG, UCL Partners & NICOR

Worcestershire County Council, Worcestershire Acute Trust, Worcestershire Health and Care Trust alongside 3 CCGs are leading the way for 3millionlives pathfinder sites, and have been the first to go to tender to find a managed service partner to support their Assistive Technology (AT) programme.

Assistive Technology (AT), incorporating telecare and telehealth, has been available in Worcestershire for several years. Described by Charles Huntington (ACS Project Team, Adult Services and Health, Worcestershire County Council) as a small 'cottage industry' team supporting local initiatives. Positive experiences of AT led to a partnership of social and healthcare providers combining their budgets and energies, and mainstreaming AT as the best way forward to deliver better care and cost savings.

"The programme is about improving the quality of service and saving money," says Charles. "Investing in early intervention and prevention in social and health care can contribute to our savings target. Currently set at £1,500,000 for AT between 2011 and 2015".

Charles continues, "If you can delay the need for further services, it benefits individuals because they want to be healthy and live independently. Small items of AT, can make a huge difference. For example, wall lights that illuminate the way to a bathroom - preventing a fall, costing very little".

The programme is seen as an online catalogue from which a GP, for example, could choose a suitable technology for a patient. The Worcestershire tender requires provision of a managed service that allows a GP or social worker to say what they require and for the managed service provider to fulfil that request.

It is envisaged that people may receive technology for a shorter period to enable better self care and management of their condition. Worcestershire wishes to be able to provide suitable technology innovations as they occur. The managed service contract is based on leasing, similar to the mobile phone contracts, with the service provider sharing the risk of the programme.

The technology does not have to be a piece of 'kit'. Charles Huntington points out that their aim is to provide the most suitable support available which could well be deploying an app on a smart phone. He says, "The programme will certainly change how personal care and healthcare are delivered".

Department for Transport (DfT): Cities rely on an efficient transport network to connect people to employment, education and services. Travel to work areas have stretched, and it is now common for someone to live an hour or more from where they work or socialise. This comes with inevitable costs to the environment, not to mention the impact on congestion.

Big infrastructure projects, like High Speed Rail and Crossrail, are transformational in shaping our future economic landscape and providing transport networks with much needed additional capacity. But for the most part we have to consider lower cost options that keep our cities moving - getting the most from existing transport assets and delivering

maximum return for transport investment. The Department for Transport is looking for smart solutions to the transport problems we face, considering new ways to shape user behaviour and ensure that our infrastructure meets customer demands, the demands of the economy, and helps it to meet challenging carbon reduction targets.

Smart technology has the ability to transform the way people use public transport, allowing them to make their door-to-door journey with more confidence. It opens up alternative ways of buying, collecting and using tickets that are often easier for passengers. For example, a ticket can be bought online and loaded onto a smartcard at the start of a journey, or delivered directly to a mobile phone. When smart technology is combined with integrated tickets that are valid on more than one operator's services, it can further simplify making door-to-door journeys by public transport. Contactless bank cards and Near Field Communications-enabled mobile phones offer exciting opportunities in transport.

A significant amount of smart ticketing schemes already operate across the UK. All of the major urban areas have smart ticketing schemes, and all buses in London and around half of all buses elsewhere in England are smart-equipped. Contactless bank cards are already accepted on buses in London, and plans are underway to extend this to other modes of transport. However, this infrastructure has not yet been used to its full potential so the DfT is working to develop and bring forward smart ticketing:

- (i)** establishing the Smart Cities Partnerships, through which DfT will work with the nine largest cities in England (excluding London) to support them in delivering and enhancing smart, integrated ticketing schemes;
- (ii)** investing £45m to bring forward smart ticket implementation across the South East with the South East Flexible Ticketing programme (SEFT);
- (iii)** including some smart ticketing requirements in all full-term newly competed rail franchises;
- (iv)** contributing around £60m for the ITSO on Prestige (IoP) project to upgrade London's Oyster equipment such as ticket barriers at stations, so that they can read both ITSO smart tickets and contactless bank cards in addition to Oyster smartcards.

Providing reliable and comprehensive audio and visual transport information, at the time that the traveller needs it, can increase passenger confidence in using public transport. Route maps, fare details, timetables and real-time arrival and departure information can be provided through a variety of sources. The Department is working in a number of areas to improve information provision, including:

- o investing £17m in the Transport Systems-Catapult Centre (TS-CC) to develop new applications that will provide consistent, comprehensive and easily accessible information. An initial priority is to improve access to real-time information for different modes of transport, and in the longer term work towards developing and launching a journey planning software application designed to assist all travellers;

- building on its *Open Data Strategy* published in June 2012, to work with information owners to remove restrictions on commercial use of data so that it can be more readily shared;
- continuing to promote DfT's Transport Direct online service (www.transportdirect.info) which enables cross-modal journey planning across Great Britain.

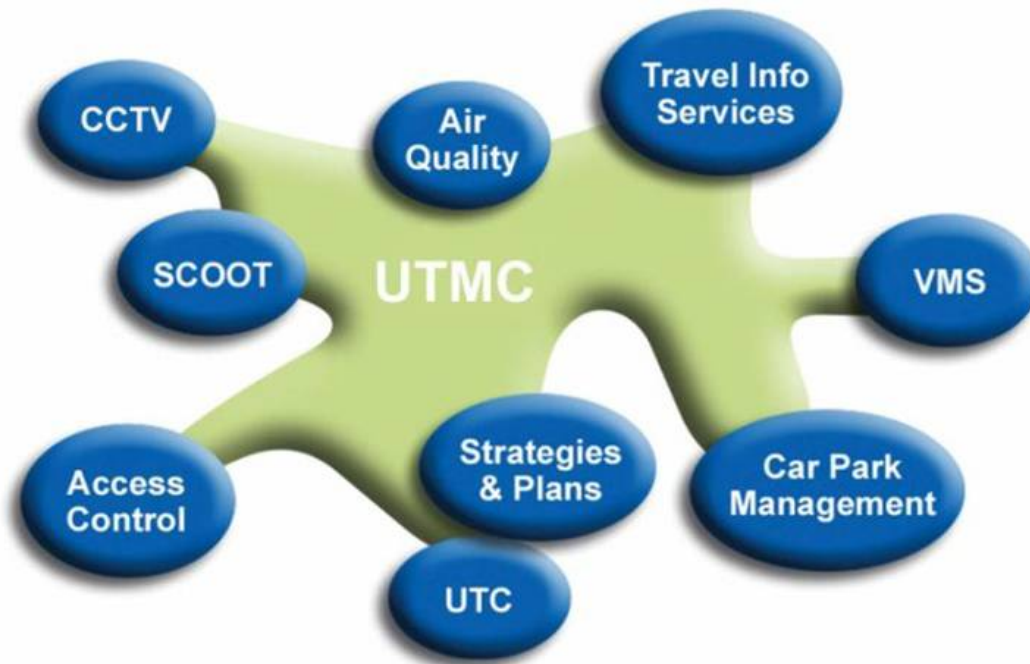
Transport data is amongst the most popular for re-use by application developers for mobile applications, such as real-time train and bus information services and applications around road congestion and traffic information. Applications and services will continue to be brought to market covering issues such as finding the best fares and personal navigation services.

Moving more journeys to sustainable modes will reduce congestion for road users and help deliver carbon reduction. DfT is supporting the transition to ultra-low emission vehicles with Plug-in Car and Van Grants, and the Green Bus Fund to help stimulate those markets, and the Plugged-In Places Programme to support the development of plug-in vehicle recharging infrastructure.

The European Parliament and Council introduced the Directive 2010/40/EU in July 2010 on the framework for the deployment of Intelligent Transport Systems (ITS) in the field of road transport and for interfaces with other modes of transport. The European Commission's aim is to accelerate and coordinate the deployment of ITS applications on the Trans European Road Network (TERN) across Member States in a consistent and harmonised way.

As a world leader in ITS, the UK recognises the EU ITS Directive as an important opportunity to share skills and experience with fellow Member States, especially given the considerable investment the UK has already made in the development and deployment of ITS.

The Department for Transport initiated the Urban Traffic Management and Control (UTMC) programme in 1997 in order to help urban local authorities in the development of a more open approach to the use of ITS in urban areas. The aim of this programme was to recognise the potential value that mainstream information and communications technologies could have in traffic management, to integrate an increasing range of ITS solutions to deliver an increasing range of policy objectives.



Example showing systems integration

These services can be provided individually, but greater benefits can be gained by integrating them into a unified system. The aim of the programme was to demonstrate how integrated systems had the potential to provide a cost effective and flexible means to manage transport in urban areas.

The UTMC initiative represents one of the most successful transfers of research to deployment in the ITS world. It has transformed the ITS marketplace in the UK over the past few years. The heart of UTMC is the open Technical Specification, developed collaboratively by suppliers and authorities under the authority of an independent professional secretariat. This ensures that it meets user needs while being practical for developers to support, and – crucially – ensures that different suppliers know how to connect to each other's products. New elements of UTMC are continually being created to meet today's challenges.

The European dimension is very important in traffic management and there have been a number of initiatives to support this. In 2012, the European Commission launched Project POSSE ("Promotion of Open Specifications and Standards in Europe") under the INTERREG IVC programme. The POSSE project is led by Reading Borough Council in the UK with national co-funding from the Department for Transport towards this project. The project will help share experiences from UK and German open specifications frameworks with roads authorities in a number of Member States (Czech Republic, Italy, Lithuania, Norway and Spain).

Reducing the need to travel can make a real contribution to tackling urban congestion. Utilising available technologies, such as teleconferencing and videoconferencing, can lead

to considerable cost and carbon savings for businesses. Encouraging more flexible ways of working, such as remote working and flexible working hours, can help ease congestion by spreading the peak travel times across the day, and improve employee wellbeing. During the London Olympics, Transport for London and DfT implemented an ambitious behaviour change programme to reduce the demand on the transport network. Commuters responded well, with over one third of Londoners changing their travel patterns to better share the network with spectators and the Games family. DfT is building on the London 2012 success, and exploring the role behaviour change and technology can play in helping to realise a wide range of transport ambitions, particularly around congestion easing, carbon reduction and economic growth.

Department for Culture Media and Sport (DCMS): With a broadband investment programme of £1.2 Billion, the Department is seeking to achieve a transformation in speeds, while maintaining a competitive and low cost market. As part of this programme, it is investing £150 million to create 22 super-connected cities before the end of this Parliament, to help provide homes and businesses with ultra-fast broadband speeds of at least 80-100 Mbp and wireless internet access. It has also earmarked £150 million, via the Mobile Infrastructure Project, to improve mobile phone coverage and quality in areas where it is poor or non-existent. Government is also working to provide, at the earliest opportunity, Superfast Broadband to all Enterprise Zones that do not currently have it.

Department for Energy and Climate Change (DECC): If urbanisation and economic development are very much two sides of the same coin, energy consumption is a good marker for both: estimates currently put urban energy consumption in the ranges of 60-80% of global energy use²³.

Smart City Heating: An integral part of building sustainable urban developments is to respond to the high heat demands in urban areas with low carbon solutions. Nearly half the energy we use in the UK is used for heating. *The future of Heating: Meeting the challenge*, published in March, set out the Government's next steps for ensuring that affordable, secure, low carbon heating plays an important role in the nation's energy mix.

The high heat density that is a feature of urban areas creates the right conditions for heat networks (also known as district heating) to be deployed cost-effectively. Networks can make the most of the range of heat sources that individual building solutions cannot harness. They can also strengthen cities' energy resilience as well as tackling fuel poverty. Networks also enable easier transition between fuel types; changing one large heat source to a lower carbon alternative is easier than replacing the equivalent number of individual boilers. As a result of this, heat networks can play an important strategic role in cities' energy mix.

²³ IIASA Global Energy Assessment 2012

The Low Carbon Pioneer Cities initiative is part of DECC's contribution to the Government-wide City Deals programme, designed to boost economic growth in our largest cities. DECC is supporting Greater Manchester, Leeds City Region, Nottingham, Newcastle and Sheffield City Region by providing over £1m for initial scoping and heat network development work. These projects increase understanding of the practical and financial issues that local authorities face in taking a project from inception to the point where it is viable for commercial investment. Although the projects have only just commenced, early insights from these have fed into the design of further support.

Building on this programme, the Government is establishing a new Heat Networks Delivery Unit within DECC. This will support local authorities to develop heat networks projects to the point that they can attract capital investment. This will include funding for heat mapping, energy master planning and feasibility studies.

Smart City Electricity Distribution Grid: The controlled use of energy is fundamental to developing the smart city concept and many of the ideas of the smart city require an energy source to function. For example, the increase use of IT in the smart city, the charging of low polluting electric vehicles and the use of electric heat pumps as an alternative lower carbon dioxide emission central heating technology, all require the increased use of the urban electricity distribution network. This is putting pressure on the local electricity distribution network (the 'grid') to supply this energy when and where it is required.

Furthermore, the increasing amount of intermittent renewable electricity generation (i.e. wind, tidal, photovoltaic) in the electricity network, as a result of policy to curtail global warming by decreasing greenhouse gas emissions, leads to times when generation is plentiful and other times when it is scarce. This requires the balancing of demand to match the supply available, at any one time, to keep the network stable.

Fortunately, several 'smart' technologies can be used to reduce this burden by making the energy networks more intelligent in controlling demand at the local level ('Demand Side Response' or DSR). As an enabler of this technology, DECC's policy is to manage a roll-out of both gas and electric smart meters to around 26M domestic and around 11M small businesses by 2020. In addition to allowing the meters to be read remotely, this will also allow tariff information to be updated as frequently as every 30 minutes, so allowing new methods for optimising the demand for and use of energy. This is especially important for lowering the costs of the electricity distribution network in future smart cities, where currently the grid is specified to be capable of handling peak loads in the city's demand profile, but where the averaged load is around 40% less than this. Applying smart technologies to the grid can therefore avoid the need for expensive new electrical feeders

and low voltage transformers as well as avoid the need to manually read meters. Consumer savings as a result of smart metering deployment are expected to be £24 a year by 2020, rising to £39 per household a year by 2030, for dual fuel domestic consumers – taking into account all the costs and benefits²⁴.

The use of DSR in the smart city will need to be supplemented by the need for local smart storage of energy to soak up excess supply when renewable energy is plentiful. This storage can be in the form of batteries, thermal storage (e.g. in water tanks or in molten salt tanks), by generating hydrogen or other gases or possibly by physical methods such as compressed air storage. These technologies are all in an immature state, so to speed local smart storage technology to market, DECC is now running a series of innovation competitions to promote developments in this field²⁵.

The Electricity Market Reform proposals²⁶ now before Parliament in the Energy Bill will enable both DSR and storage solutions in the smart city to be realised commercially before 2020. DECC are taking powers to run preparatory auctions for delivery of DSR and small scale storage. These small-scale auctions will assist industry in building their capacity and capability before the first 'live' full-scale auction to supply DSR and storage takes place post 2017.

A recent report²⁷ has been published that describes and analyses smart grid demonstration projects elsewhere in the world. Worldwide, the network operators are already investing approximately 1.5 billion EUR per year in the replacement and expansion of their networks. In the period up to 2050 an extra investment of between 20 and 70 billion EUR will have to be made to adapt energy networks to meet demand and to make them more intelligent. Clearly, smart grid and storage technologies are a major potential source of exports for the UK.

²⁴ DECC 2013 Smart Meters Impact Assessment
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/78666/IA-Feb.pdf

²⁵ DECC Energy Storage Innovation Competition latest information is available on
<https://www.gov.uk/government/news/20m-up-for-grabs-for-energy-storage-innovation>

²⁶ Electricity Market Reform Information Website:
<https://www.gov.uk/government/policies/maintaining-uk-energy-security--2/supporting-pages/electricity-market-reform>

²⁷ 'Global Inventory and Analysis of Smart Grid Demonstration Projects', DNV KEMA Energy & Sustainability, October 2012

Local Energy Generation: The Smart City also requires a large number of other innovations in local generation. Photovoltaics and solar thermal can also be used to a greater extent to provide local energy supplies. Wastes, including household 'black bin bag' waste, commercial waste and biomass arisings from parks etc. can be used to a greater extent to generate useful fuels in these cities. For example, waste can be gasified to form a synthetic fuel gas, which can be either combusted to generate power or further converted to a liquid transport fuel in a catalytic process. Further details of the technology for generating energy from waste in smart city scenarios has recently been published on the DECC website²⁸.

Fostering Energy Innovation: The UK supports innovation in smart city energy technologies through a number of funding streams. For example, Ofgem's Low Carbon Networks Fund (LCNF) has made £500 million available to network operators over 5 years (2010-2015) to trial new technologies and approaches. Over 120 innovation projects are now being funded directly by DECC through its Entrepreneurship Scheme funding²⁹. In addition, several government departments invest in the various stages of low carbon energy innovation through the TSB and Research Councils, coordinated by the Low Carbon Innovation Coordination Group (LCICG). Together the LCICG members are investing in a diverse portfolio of low carbon technologies with investment decisions informed by a shared evidence base (the Technology Innovation Needs Assessments (TINAs)³⁰) and with the twin goals of maximising the impact on energy targets and UK wealth creation.

²⁸ <https://www.gov.uk/generating-energy-from-waste-including-anaerobic-digestion>

²⁹ Further details on DECC's low carbon innovation programme can be found on the DECC's innovation funding web page: <https://www.gov.uk/innovation-funding-for-low-carbon-technologies-opportunities-for-bidders>

³⁰ TINAs published on the LCICG website: www.lowcarboninnovation.co.uk

Case Study

Scottish & Southern Energy Low Carbon Networks Fund Project

New Thames Valley Vision (NTVV) will revolutionise the way in which Distribution Network Operators (DNOs) utilise their existing networks in urban areas. This project is a complete solution that will allow DNOs to anticipate, understand and support behaviour change in individuals, small businesses and larger companies to help them manage energy demand more effectively as the UK moves towards a low carbon economy. Building on the techniques developed for supermarket loyalty schemes, NTVV will use data intelligently to identify and predict network stress points in the short, medium and long term in order that DNOs can make more informed decisions. NTVV will evaluate solutions, including: a new network and planning environment for industrial and commercial (I&C) and small and medium sized enterprises (SMEs); automated demand side response; low voltage (LV) static voltage control; street level energy storage; and a range of communications solutions. The project will incorporate learning from other projects in the UK and worldwide. NTVV will deliver new commercial agreements, procedures, policies and will inform national standards. It will disseminate learning through targeted communication and a low carbon community advisory centre. Ultimately, NTVV will enable DNOs to avoid £5bn of network reinforcement through the involvement of all customers groups and a comprehensive understanding of networks.

Participating in EU Programmes

The European Commission has signalled its commitment to developing a Europe wide capability in developing Smart Cities by establishing a European Innovation Partnership (EIP) on Smart Cities and Communities³¹. The Commission is being advised by a High Level Group which, in turn is supported by a team of experts drawn from business. Representatives from the UK are actively shaping this activity. Possible areas of work in this EU context include:

- Sustainable mobility;
- Sustainable digital infrastructures;
- Low-energy, connected buildings and districts;
- Smarter decision-making in urban planning and in daily life.

³¹ Commission Communication on Smart Cities October 2012

The aim is to support cities and regions in taking ambitious and pioneering measures to progress towards a 40% reduction of greenhouse gas emissions by 2020, through sustainable use and production of energy. This will require systemic approaches and organisational innovation, encompassing energy efficiency, low carbon technologies and the smart management of supply and demand, particularly with regard to buildings, local energy networks and transport.

The European Council has welcomed the proposal and invited the Commission to come forward with a more detailed Strategic Implementation Plan to determine the scope of the activity, how it might complement activities in member states and the funding arrangements. This is expected to be published in December.

We will seek to engage with this EIP as a means of helping cities and communities, business and civil society here in the UK to implement smart city solutions at much greater scale and speed, by connecting local initiatives (existing partnerships of local government, business and community-based organisations) with best practice and experience from our European partners.

Growing through Exports

As we have noted, the pace of urbanisation in the developing world brings opportunities for UK companies with smart solutions and new and innovative technologies in the Built Environment, Energy, Health and the Digital Economy. The Government's strategy, to help such companies maximise these trade opportunities, comprises:

- Influencing Overseas Governments and Public Authorities to integrate smart city solutions into urbanisation programmes whether adapting existing urban centres or building new ones. For example, with 50% of new buildings being constructed between now and 2015 in China, the Foreign and Commonwealth Office's (FCO) Prosperity Fund has supported a number of projects including:
 - the Institute for Sustainable Communities' work on accelerating energy efficiency, retrofitting and energy performance in Guangdong Province's public buildings, as a model for replication nationally, to deliver a step change in China's Built Environment;
 - the piloting of effective policies and implementation strategies for Eco-cities in China by the UK- China Eco-Cities and Green Buildings Group and China's Society for Urban Studies;
 - a joint project between London University and Sichuan University so that, by the end of 2013, the Sichuan Government is equipped with low carbon city development models adapted to the province's specific needs

Developing awareness of opportunities for UK expertise and bringing them to the attention of UK companies. For example:

- UK Trade & Investment (UKTI) published a “Smart Cities Of The Future In Asia” report in February, which identified over 100 opportunities for UK businesses.
- Under UKTI’s High Value Opportunities Programme, UKTI Taipei estimates the total investment value of the Taiwanese Government’s pilot eco-city project programme to be £2bn and UKTI are engaging with Taiwanese stakeholders to explain the UK’s proposition and to position relevant UK companies.

Bringing UK companies to the attention of the procurers. UKTI organises trade missions where companies can meet buyers and business partners, and present their knowledge and expertise to key decision-makers leading to increased visibility, brand recognition and the building of lasting business relationships. For example:

- The ‘Smart Cities, Smart Living Mission’, led by Minister Alan Duncan to Singapore, Malaysia and the Philippines in December 2012. More are planned for this year.

7. Barriers to Adoption and the Business Perspective

Despite these wide ranging interventions, progress with respect to smart cities, including truly integrated systems, has been rather slow. There are particular reasons which might inhibit uptake.

(i) Information Failures: While the case studies, both UK and overseas, indicate there is some understanding of certain issues/challenges that cities face and how the application of smart technologies can mitigate these, no fully integrated smart city has been established to demonstrate the benefits of such a system. As a result, there is no reliable information available to cities or service providers on the costs and potential benefits from it, or the difficulties associated with implementation.

(ii) Coordination failures: Furthermore, some of the benefits will only become apparent once systems have been fully integrated, due to so-called network effects i.e. the larger the number of participants on a particular system, the greater the benefits to all users. However, the scale of the investment and the complexity of the networks involved, to link up and work together to develop a smart city system, makes it extremely difficult for any one organisation to harness the resources to take a lead in co-ordinating the activities. It falls to the city authorities to do so, but the risks and information failures favour caution.

(iii) The inability of cities to gain first mover advantage: Thus, although it may be in the interest of private sector service providers to urge innovation on city authorities, in order to learn from experience and develop reference material, for the city itself, there is no such advantage. At a time of financial constraint, the optimum strategy for city leaders is likely to be that of “early follower” to learn from others’ experience while being seen to be in the early cohort of innovators.

(iv) Finance for innovation in public services and the challenge of roll-out:

Whereas, in the USA, pilots and demonstrators to develop new innovative approaches to public service delivery can access private capital, city authorities in the UK have to rely on Government programmes in specific areas eg smart grids or intelligent transport. With the exception of the recent large scale Demonstrator awarded to Glasgow, there has been no Government funding available for more systemic or integrated approaches to the delivery of services. Furthermore, while cities can see the potential attraction of citizen centric, service models, there is less clarity on how to develop sustainable business models, when such services are rolled out in partnership with the private sector. However, the UK is not unique in Europe in experiencing difficulty in adopting more integrated approaches to

public service delivery: this was also highlighted by the European Commission following its public consultation on smart cities.³²

(v) Inclusivity of public services: Furthermore, while recognising the advantages of channel switching to internet delivery, local authorities remain concerned about maintaining the inclusivity of their services and ensuring that all citizens can embrace new forms of delivery.

(vi) Fear of lock-in: Due to the characteristics of software and associated systems, cities have expressed concern over the potential for proprietary business lock-in, in relation to smart applications and systems. This is reinforced through network effects, as more service systems join the same network, and the cost of moving to a new system becomes prohibitive. Ensuring the interoperability of systems through open standards is considered essential in order to remove such concerns and enable new approaches to be adopted across the EU and in global markets.

(vii) Trust in data privacy and system integrity: Smarter and more highly networked systems will inevitably share more data about users, raising some risks that unauthorised use or criminal access to systems could breach individuals' privacy. There are also potential vulnerabilities to deliberate disruption by Hacktivists or other malicious actors. It will therefore be important for wider uptake that users are assured that the information which is collected, stored and transmitted about them is secure, and that privacy is maintained. Good Cyber Security implementation will be essential; and clear communication with service users about how data about them is used and protected, and how the use of that data benefits them, will help build trust.

The Business Perspective: The Information Economy Council considers the concept of smart cities as a key growth pole of the UK economy in years to come and it is supported in this view by the Professional and Business Services Council (PBSC). In its response to the IE Consultation, Intellect - the trade association which represents firms in a broad range of technology sectors associated with the Information Economy - considered the barriers to the development of the concept in the UK to be as follows:

- The existing infrastructure investment and diverse ownership, plus cost of roll-out. Legacy infrastructure is a particular issue and the way in which the UK deals with smart cities will be different from those cities in the developing world.
- The widespread adoption of smart city concepts is complicated as each city has different priorities and consequently it is not a matter of applying a tested pattern. For some cities, unemployment and skills development is critical, for others crime control is the top priority and for others economic success may be causing sustainability issues. Each of these cities will apply smart city concepts differently to address its highest priority concerns.

³² European Commission, 2012, Communication from the Commission – Smart Cities and Communities – European Innovation Partnership;
http://ec.europa.eu/energy/technology/initiatives/doc/2012_4701_smart_cities_en.pdf

- The TSB's sponsorship of the Future Cities programme and BIS's sponsorship of the development of PAS 181 are useful first steps and it will be interesting to follow the progress. There is unlikely to be a single pattern for a smart city, it would be beneficial to sponsor a number of pilots, each with distinct social/economic priorities. Additionally, the UK government should put mechanisms in place to share "best practice" while cities experiment with differing approaches.
- The major barrier is often engaging government departments and local authorities to support delivery. Systems are often siloed and not suitable for integration. This needs a whole new way of thinking. Small projects, from the ground up, slowly creating a capability around new solutions and services will eventually make the market.
- Aged infrastructure in UK cities makes widespread deployment expensive, as demonstrated by the disruption created by installation/upgrades to fibre-optic installation. Complicating the issue is fragmented governance of major cities that reduces the chances of a long-term strategic vision being developed that guides/accelerates solution of planning issues.

In its recent advice to Ministers, the PBSC addressed the barriers to uptake by emphasising the importance of:

- using the Glasgow Future City Demonstrator as a "lighthouse" project and encouraging UK cities to collaborate in defining their own urban challenges, in order to create a market and potential scale economies;
- creating modular solutions, with the support of the TSB Catapult, which could be adapted to meet specific needs in a cost effective manner;
- engaging with citizens, using the latest innovative approaches eg social media, and incentivising radical solutions to challenges which capitalise on the creativity of UK SMEs;
- promoting the release of public re-usable data, using stakeholder groups to advise on priorities and new approaches;
- developing a forum to promote trust and confidence in public/private partnership and support city leadership in developing a fully sustainable vision for their communities; and
- benchmarking the performance of UK cities, not only between themselves, but also with other centres of excellence.

In summary, it is clear from our discussions with representatives from UK cities and the business community that there are significant barriers to local authorities adopting new approaches. This is based on genuine concerns about affordability, the prospects of success and their own ability to manage change. We consider below how cities overseas have addressed these barriers and, in the following section, the steps we need to take to strengthen UK capability in the years ahead.

8. What can we Learn from Overseas Experience?

In order to measure UK performance against overseas experience and to learn from it, Arup prepared a series of case studies, including interviews with city leaders, relating to the following six cities: Boston, Chicago, Stockholm, Barcelona, Rio de Janeiro and Hong Kong. This section summarises the barriers to be overcome and the key success factors. As noted earlier, the case studies are reported separately.

Barriers to Success: The barriers to change identified in our international case studies are familiar:

- The lack of a vision and an innovation culture in city government.
- Funding for investment
- Procurement rules which inhibit innovation
- Data-use legislation

However, while the response to these barriers may also strike a chord, it is the systematic approach to change, based on the power of information, which is central to addressing the challenges faced by the city, which distinguishes the cities in our case studies from UK experience.

Developing a Vision, Displaying Leadership and Public Engagement: Unsurprisingly, it is the appointment of a new Mayor which is often the driver for change and the development of a new vision. For example, in the case of Chicago, it was the election of Mayor Emmanuel in May 2011, with a vision of how ICT and Open Data could transform city services - the city as a platform - that sparked change. Similarly, in Rio, access to data and efficient project management became central to Mayor Paes' vision in responding to the challenges posed by natural disasters (the 2010 landslide) and the need to deliver a successful World Cup (2014) and Olympics (2016). Its televisual Centre of Operations, collating data from over 30 Departments, as well as public utilities, has become the embodiment of an integrated approach to service management, which continues to evolve. For Stockholm, its long standing association with Ericsson and willingness to experiment with advanced ICT, combined with its 2030 target of carbon neutrality, forms the core of its vision as a smart city. For Boston and Mayor Minino, it is quality of service delivery, particularly education, citizen engagement and his vision of Boston as a laboratory, willing to share its experience with others, which lies at the heart of the city's drive for smarter approaches. In all cases, citizens are encouraged to participate in the process of service improvement and in the development of new approaches and new services. Furthermore, it seems from these cases that cities form visions which are specific to their needs, but one of the underlying success factors is the commitment from the top to drive through change and innovation to achieve quantifiable objectives.

Promoting Innovation and Systemic Change in Public Service: Our study suggests that, in addition to vision and leadership, innovation and change in the public sector can

benefit from private sector mechanisms and experience: “skunk works” with the freedom to try new ideas and ability to manage risk, access to capital - internally or externally generated, and a strong focus on measuring outcomes and the ability to scale up have been critical to success.

Organisational Structure: Successful approaches for smart city leadership require a group of people within the organisation who are able to innovate and act entrepreneurially. These groups (incubation hubs, such as Boston’s Office of New Urban Mechanics, Chicago’s Smart Chicago Collaborative, or Rio’s Centre of Operations) are able to play an active role seeking out new opportunities, piloting new ideas and approaches, and forging relationships with city stakeholders (including SMEs, service providers, universities etc.). These sections of the organisation must have strong political support (usually situated in the Mayor’s office, or executive team) and a clear mandate that gives them credibility and focuses their agenda on innovation.

However, these seemingly separate groups need to be seen to be supporting operational delivery and positively linked to the rest of the organisation. Thus, they should:

- innovate in areas relevant to the operations side of the organisation, so they must be closely aligned to the key challenges encountered by their internal clients.
- access the services and operations of the operational side of the organisation, so that they can pilot innovative products and services and deliver really valuable feedback to the service providers.
- pilot and scale up new business models, not just technologies, so a link to the actual organisation is essential.

Sitting outside of the operational functions of the city, success depends upon building credibility and trust with their internal clients, so that successful pilots can be rolled out as mainstream services.

The role of ‘incubation groups’: These groups generally hold a sophisticated understanding of the strategic role that technology can play in solving the city’s challenges. They are given the freedom to support growth and investment in this area within the city organisation as well as the wider city. Typical roles include:

- setting the agenda/ strategy/ vision for ‘smart’ in the city.
- acting as a matchmaker for city stakeholders. To fulfil this remit, these groups need an understanding of strategic dependencies between service providers, the opportunities for innovation and mutual benefit, and then to facilitate connections in order to work across silos.
- working closely with city vendors to provide the city as a ‘test case’ for their new technologies. This way the council receives products and services at a significant discount, and the vendor is able to obtain high quality feedback, learning and proof of concept. This then enables the product or service to be scaled up (proven value case means that the government would be more willing/able to pay for it), and for the project to act as a reference case for other cities.
- providing, as part of the city’s regeneration strategy, opportunities for small firms to demonstrate their innovative capacity, simplifying procurement below a \$100,000

threshold, and supporting the growth of successful SMEs and start-ups, to make them investment ready when they approach traditional venture capitalists.

Access to Capital: A key factor in the failure of government to innovate is the level of information and confidence required in relation to project success, and associated wider benefits, before public funds can be committed. However, creative, exciting ideas that are innovative also very often have benefits associated with them that are difficult to establish/estimate. Having a separate body within the organisation that is resourced and is able to test these, or to adopt “real options” approaches to identifying radical solutions, provides the operational parts of the organisation with the information and confidence necessary to scale up and implement.

Furthermore, part of the skill-set and knowledge of the key members of the incubation team is how to access private grants for innovation from charitable foundations or business. This form of funding for innovation, which seems to be more readily available in the USA than in the UK, can be used to fund pilots/demonstrators to provide a test bed for proving technologies as well as business models and the value case. Over time, these pilots can begin to tackle more complex and sensitive topics. In Stockholm, for example, the city set aside its own innovation fund of €70 million, in 2006/07 to fund innovative projects, in order to establish e-Government services for the city; in 2012 the city has a surplus of over €200 million which it can retain to invest in future ICT.

Measuring Success: Leading exponents of smart city concepts from the case studies believe that clarity of objectives and expected outcomes is important whilst recognising that wider or secondary benefits - positive unintended consequences - can be even more powerful elements of success. The key appears to be to set hard, quantifiable metrics e.g. the number of citizens engaging on-line with the city authority, while also measuring broader outcomes. To do so, some cities have collaborated with universities to establish base-lines in order to identify the longer term impacts of innovative approaches to public service delivery.

Open Data: Open data is seen as a key driver of change. This goes way beyond the accountability of public funds. Leading cities are now consulting citizens on the issues which exercise them most and then exploring how information might be brought to bear on the topic. They are examining how to generate more powerful insights and value by using potentially more sensitive datasets (including data on vulnerable groups) in order to improve their understanding of citizens’ needs and to provide better services, while respecting data privacy and security. They are also making available large datasets to enable new APIs and services to be developed commercially. Smart cities see ICT and the innovative use of data as fundamental to solving their most complex challenges and Chicago’s open data strategy now forms part of individual department budgets – not an “add-on” or “nice to have” but formally recognised and institutionalised.

Social Inclusion: The cities in all our case studies are taking active steps to engage with all parts of the community, to promote awareness and uptake of the e-services on offer. For example, Stockholm offers widespread and competitive access to broadband services, consults its citizens on the services provided, and works within the education system to promote uptake for all. Rio’s approach was born out of the need to provide a more timely and effective response to natural disasters and, through its Operations Centre, it seeks to

inform and engage with all citizens, not only through mobile and social media, but also TV and radio stations, which operate from within the Centre and have access to all the information and film footage. Chicago has a wide range of activities to support social inclusion, including a network of 250 locations in the city with access to digital skills training and free online learning resources; health information specialists in low-income clinics to help patients connect to their medical records; and, in five disadvantaged neighbourhoods, it has provided computers and training opportunities to more than 11,000 residents and 500 small businesses.

9. Looking to the Future: Developing UK Capability over the Medium Term

It is clear from this report, and its supporting evidence, that meeting the needs of urban communities will be a key driver of growth in the decades to come, in this country and worldwide. While it is for each city in the UK to develop its own vision and strategy for the benefit of its own citizens, central Government has a critical role to play in continuing to strengthen the UK's overall capability, so that cities have access to knowledge and experience and are able to share services, or implement the successful approaches of others, with a reasonable expectation of the cost/benefits of innovation. This is a broad agenda and this report indicates the range of activities already underway. However, this report also reveals four main areas where the Government needs to focus its efforts, and work in partnership with business and cities themselves, to strengthen UK capability and performance:

- Continue to work with cities to empower them to show visionary civic leadership to their digitally engaged citizens;
- strengthen the UK research and knowledge base in the area of smart/future cities, encourage innovation, and improve dissemination of the cost and benefits of adopting new approaches, including the viability of new business models, the risks involved and how to mitigate them;
- promote the concept of public re-usable data in a city context, and develop the open standards that are necessary to enable data sharing and systems integration, in order to facilitate the move from “smart buildings” to “smart communities” and “smart cities”, i.e. the realisation of the “Internet of Things”;
- encourage firms, particularly SMEs, to strengthen their capabilities and offerings to capitalise on the evolving supply chains of utility service systems e.g. intelligent transport systems, integrated energy networks, assisted living/telecare, and enable UK business to exploit its expertise in global markets.

(i) Improving Government support for Smart City leadership

Both city authorities and business have pointed to the wide range of Departmental interests which are relevant to the concept of smart cities. However, this range also gives rise to a fragmented approach: stakeholders also point to the lack of ownership and leadership in Whitehall on this subject. They believe that a stronger Government focus is important when other countries are developing capability, when the EU Commission is developing its own policies in this area, and when the market for smart solutions to city challenges is rising rapidly in the developing world.

Cities have also referred to the importance of the findings of the Heseltine Report in giving them greater flexibility and responsibility to address the challenges which their cities face. The Government's response to the Heseltine Report was included in the Chancellor's Budget Statement.

Action: *The Government will form a Smart Cities Forum, comprising representatives from the main stakeholder groups, to advise Ministers on policies to place UK cities and business at the forefront of developments. BIS will provide the Secretariat and establish a Whitehall network of interest, comprising representatives from Departments with a major interest in smart systems, to strengthen co-ordination of policy in this area. It will ensure all Departments share ideas and proposals for developing smart pilots and demonstrators in order, where possible, to develop synergies, and provide all stakeholders with an overview of developments. As a first step, officials will develop a map/matrix of smart pilots and demonstrators, and publish it on data.gov. The Secretariat will act as a single point of contact in Whitehall, liaising with cities on developments and co-ordinating UK policy in relation to EU activities and policy. It will also act as a source of expertise, supporting UK cities in their attempts to develop smarter approaches by keeping abreast of international developments.*

(ii) Strengthening the Knowledge Base and Dissemination

Both RCUK and the Technology Strategy Board have taken important steps to build capacity. We need to evaluate the impact of current interventions to determine whether the current approach and level of resourcing is correct.

Action: *To work with the Technology Strategy Board in monitoring/evaluating current projects and demonstrators.*

(iii) Promoting Access to Public Re-Useable Data

As the section on policy towards Open Data has indicated, the government has made important strides in this area. However, consistent with the Shakespeare Review of Public Sector Information[33], both business and cities consider that the UK should be more ambitious in releasing public re-useable data in order to transform the information services available to citizens and take a lead in the application of data analytics.

Action: *the Government will explore with stakeholders the idea of a pilot in two cities with a view to opening up new datasets relevant to the chosen cities, in order to understand better the value of such data when linked with public sector information provided by the city, as well as information from other sources.*

(iv) Developing a Strategic Approach to Open Standards, Data Management and Data Sharing

Our work has also revealed that, if we wish to promote the uptake of new approaches and the sharing of data, then we need standards and protocols to give confidence to all stakeholders, not least citizens, in the integrity of the system.

Action: BSI will collaborate with the Technology Strategy Board's Future Cities Catapult Centre and Demonstrator Programme in the delivery of these projects. This will allow the benefits of the standards programme to support the delivery of the TSB projects, and ensure the capture and dissemination of learning from the TSB programme. Working with an Advisory Group, BSI will identify where standards and guidelines can address the key barriers to adoption of smart approaches, such as developing a robust business case, and developing good practice in addressing important ethical issues, such as securing citizen consent and transparent communication. To embed standards in the process, TSB and BSI should consider deploying a standards expert in the Future Cities Catapult to work alongside the technologists. BSI will actively build relationships with other standards bodies and standards developing organizations with an interest in smart cities, both in the UK and internationally, to align programmes of work, build on existing knowledge and seek mutual recognition of compatible standards. This will enhance UK's thought leadership in this field and ensure a level playing field for UK-based businesses.

Action: We will lead work, through the Cabinet Office's Standards Hub, to discuss and select open standards and implementation frameworks that resolve the interoperability challenges which cities face. The Government will support moves to rationalise Information Governance regimes across public services and develop a 'smart city concept model' derived from its wider work on public service concept models. BSI will work with the LeGSB, the ODI, the two pilot cities, and Government to promote a smart city concept model and its delivery in a linked data format. CLG and BIS will work with the LeGSB and the ODI to develop open data standards through the Standards Hub so that a wide range of users can get involved in solving the challenge of sharing data about cities with confidence.

Action: The BIM Strategy Team will work with LeGSB and BSI to ensure that the data derived from smart buildings form part of the data assets of a smart city.

(v) Understanding Evolving Supply Chains

As we outlined earlier, the global market for developing smarter utility infrastructure is expanding rapidly and the UK is perceived to have a competitive advantage in designing and delivering integrated solutions, which are secure and resilient³³. We need to capitalise on this advantage and ensure that the UK is at the forefront in this field. In doing so, we recognise the central role of UK cities in being demanding, intelligent customers for innovative offerings, and the importance of opening up UK supply chains to innovative SMEs.

Actions: The Government will encourage business to develop responses to the call for proposals by the AMS Supply Chain Initiative. It will also seek to use the SBRI Programme to encourage SMEs to take a more prominent role in coming forward with smart solutions to city challenges.

³³ op cit Arup Report on Supply Chains

ANNEX A: Standards and Protocols.

Critical to maximising the benefits from Open Data is the ability of authorised people from the same, or different, organisations to share information, in order to develop a holistic view of, or new insights into, the issue or theme they are addressing. Sharing data between agencies is eased when trust is based on a common information governance regime from which a relevant subset of common ‘measures’ can be agreed, for a particular data exchange. At present, there is typically a separate set of Information Governance requirements, from each department that shares data, which typically come with no common way of combining three key elements:

- Semantics – the meaning of information
- Syntax – the format of information
- Data Quality – the confidence to re-use information

One of the main barriers to our ability to share information effectively is the fact that different organisations collect information for different purposes and attach a different meaning or interpretation to it. The key to success is to rationalise Information Governance regimes across public services and to address the semantics, or context, of information. Sheffield City Council is developing such a single ‘Information Governance Toolkit’ for Local Government, with measures based on the ‘Department of Health Information Governance Toolkit³⁴’. Furthermore, the Local eGovernment Standards Body (LeGSB) is creating a Public Service Concept Model³⁵ (PSCM). This recognises that departments each have their own concept model that describes their own activities and outcomes but it seeks to define common concepts such as:

Case	Location
Event	Organisation
Function	Metric
Service	Objective

It then defines patterns for how they are typically linked. The LeGSB considers that a Smart Cities Concept Model, derived from the PSCM, could considerably enhance the ability of city organisations to share data by providing a simple neutral language to describe each data source, and the links between them. This approach could lead to a common agreed expression of the issues facing a city, such as: Congestion; Troubled

³⁴ <https://www.igt.connectingforhealth.nhs.uk/>

³⁵ <http://www.pauldcdavidson.com/pscm/>

Families; Skills; and an Ageing Population and Dementia, and identify the different organisations and interventions addressing specific aspects of a particular need.

Importantly, bringing this data together should avoid attempting to store all of the information in one place. Modern data publishing techniques enable each organisation to publish their part of the story over the web, and bring it together (as linked data) to meet a particular need. A relevant example can be found at Bristol City Council where they publish Air Quality readings as 'Linked Data'. The data underlying this visualisation is publicly query-able and uses common concepts and definitive sources for terms for Location, Time, Pollutant etc.

See <http://bristol-data-epimorphics.dyndns.org/>

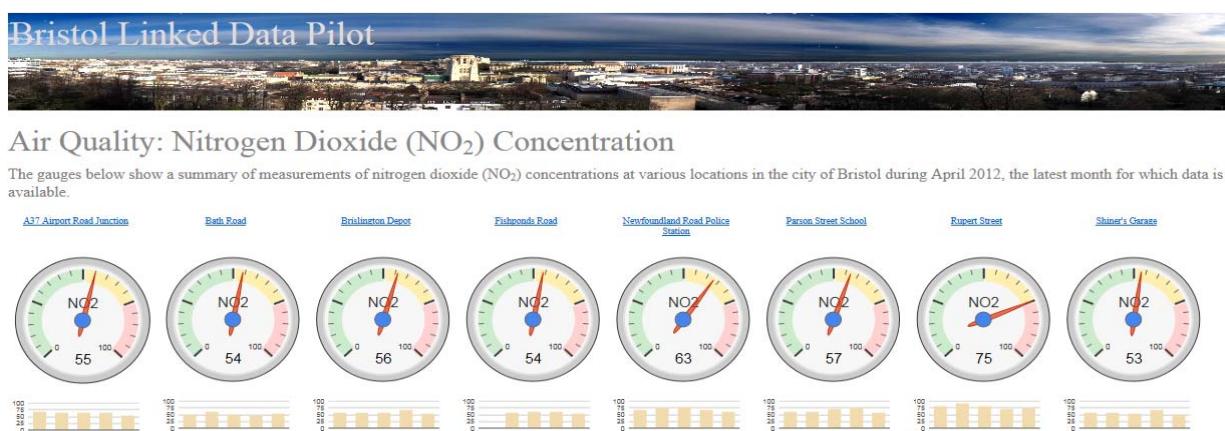


Fig 3. Bristol Linked Data Pilot

Data Flowing from Construction Assets. Much of the work on data sharing described above relates to programme interventions and outcomes, with a view to targeting policy interventions more effectively. At the same time, the Government is seeking to raise the productivity of the construction industry and the performance of buildings by developing more integrated approaches to the management of data in all the phases of a project, including its operational use – a concept known as Building Information Management, or BIM. The Government BIM programme is an integral part of the Government Construction Strategy and is designed to use “open sharable asset information” to improve productivity, collaboration and transparency in the development, delivery and operational/in-use phases of construction projects. The strategy and progress towards adoption are fully described at www.bimtaskgroup.org.

The challenge for BIM is how to capture all the information relating to both the construction phase and in-use performance, such as its energy efficiency and emissions. It is this ability to join data on the performance of individual assets with other key functional information, from other sources, which will deliver completely new strategic insights for the benefit of business, social enterprise, local authorities and consumers alike in a wide range of applications, including:

- Transport usage (e.g. Oyster Cards)
- Patient records (anonymised/pseudonymised)
- Financial Performance
- Environmental Performance
- Social Measures
- Market Futures
- Energy Generation and Distribution
- Food distribution

Standards: More generally, the importance of standards has been a recurring theme of our discussions. BSI has established a Smart Cities Advisory Group, comprising representatives from cities, business, academe and NGOs. It has identified a number of issues where barriers to smart city implementation can be reduced and progress accelerated through provision of standards. The benefits of this approach will include sharing of good practice on development and implementation of new service models, identifying common solutions to technical problems, setting out the preconditions for interoperability of data and city systems and describing ways in which risks can be managed and mitigated.

The current smart cities standards work, funded by BIS, will provide a foundation of knowledge to help establish a common vision for smart cities. The first stage of work will focus on establishing a common understanding of the benefits of smart cities and the approaches that can be taken to improve city performance. Specific projects include:

- Providing an overview description of a smart city to provide a basis for communicating the benefits of smart cities to key decision makers
- Establishing common terminology for smart cities, promoting a shared understanding of concepts (PAS 180)
- Preparing smart city planning guidelines to set out how major new residential, retail and business developments can support the wider plans of that city to become smarter
- Setting out principles for economic assessment and funding of smart city initiatives, covering the potential business models and means of procurement
- Providing a decision-making framework for smart city leaders, setting out how to deliver a smart city project (PAS 181)
- Developing a smart city data concept model to promote the sharing of data between different agencies within a city
- Mapping the current smart city landscape across different standards bodies internationally and sharing best practice
- Contributing to ISO standards on sustainable community development, global city indicators and infrastructure metrics

Beyond this, the Advisory Group has identified further issues that should form the basis of a more detailed standards programme, addressing specific practical issues and risks that will be encountered in roll-out of smart city programmes. These will include:

- Standards around good practice in provision of digital services, including sharing of open data, protection of privacy and inclusiveness of services
- Standards for evaluating smart city performance, building on the current ISO programme to provide a means of evaluating the effectiveness of smart city products and services
- Standards around procurement of smart city services, building on the initial economic assessment and funding model
- Practical approaches to collaboration between partners in delivery of smart city programmes.
- Specific standards relating to interoperability of systems, including a framework description of smart city systems building on the mapping work

The UK good practice created through BSI's work will be offered for adoption internationally through CEN/CENELEC, ISO and IEC as appropriate, contributing to international recognition of the UK as a global hub in smart city applications. BSI will take a leading role in European and international standards activities, actively working to align programmes across standards bodies, building on existing knowledge and sharing UK initiatives with other countries to create a global framework for smart cities knowledge.

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This publication available from www.gov.uk/bis

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BIS/13//1209