

UK SMART CITIES INDEX

FOREWORD

Huawei, a Fortune Global 500 company and a leading global provider of global information and communications technology is proud to present its 2017 UK Smart Cities Index. In just 18 months since the last report, we have seen significant technology advancements in the way we get around, care for our citizens, communicate and fuel our towns and cities. These advancements have reinforced the role that Smart City technology must play in tackling the biggest challenges facing the UK.

This report builds on and expands last year's Index, looking at 20 cities each deploying Smart City technology to tackle urban challenges. This year's broader remit is testament to the enormous progression in the UK's smart technology capability and the commitment of cities to using this technology to deliver benefits for their local communities. This report also highlights the key developments elevating the UK's smart capabilities and identifies lessons to be learnt from the most successful early adopters.

The continuing proliferation of data represents a huge opportunity for the UK. Those cities harnessing and exchanging data safely and securely have the potential to make enormous advancements in the fields of healthcare, energy, mobility, education and sustainability. This report provides an assessment of smart city development in the UK, highlighting best practice across the country and across these key sectors.

At Huawei, we have been working with cities and businesses around the world to engineer these breakthroughs. Our global success stories include delivering e-Government, Smart Healthcare, Smart Transport, Safe City and Smart Grid solutions in Brazil, Nigeria, The Netherlands, South Africa, China, Russia and beyond.

In the UK, Huawei is working with partners across industry and local government to deliver solutions that improve the experience of citizens as they heat their homes, interact with one another and go about their daily lives in their cities. Alongside our Smart Cities Indices, our work in this space is helping to shape the UK's future urban landscape and enhance the lives of the people who live there.

Since opening our first office here in 2001, Huawei has been helping to build a digital infrastructure that can support the wealth of innovation and ingenuity in the UK. We are delighted to continue working with partners, customers, government and the ICT sector, applying our knowledge and expertise to an area that has such potential to transform the lives of UK citizens and consumers.

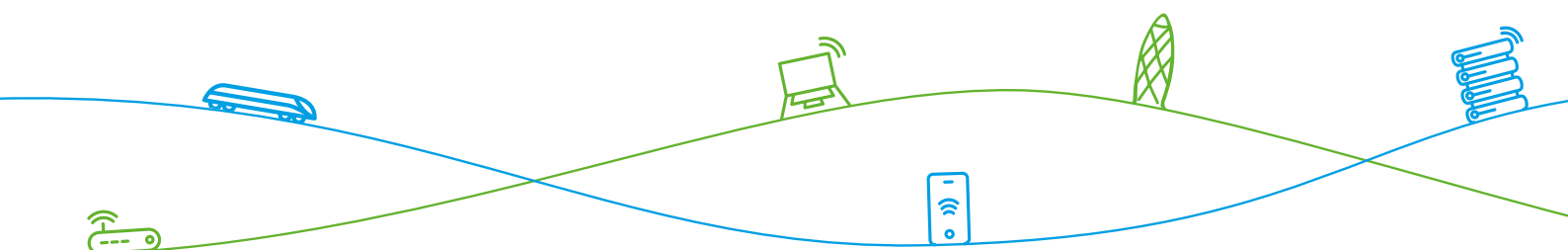
Lord Browne of Madingley

Chairman, Huawei UK

Huawei Smart Cities contacts:

Robert Yangchen, MD, Enterprise Business Group | rc.yang@huawei.com

Chris Hill, Director, Enterprise Business Group | chris.hill@huawei.com



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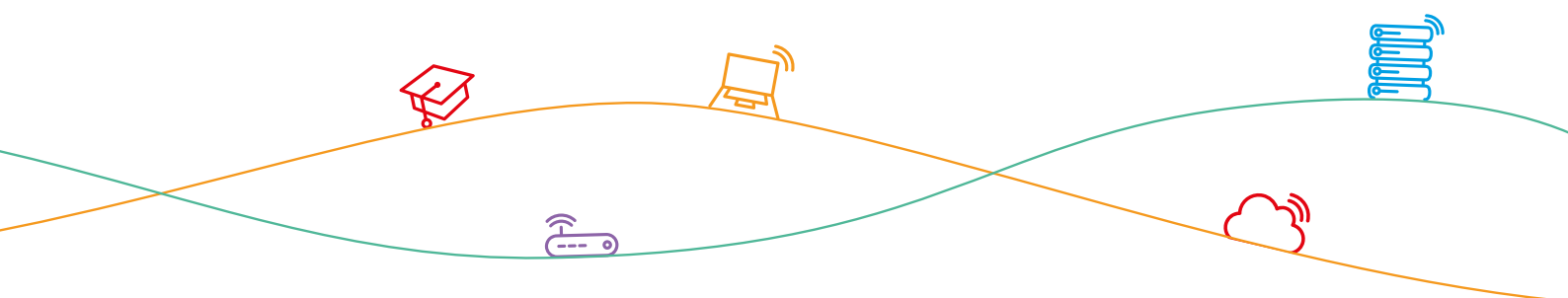
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SECTION 1

EXECUTIVE SUMMARY

1.1 Introduction

This report builds on and significantly extends the UK Smart Cities Index 2016. Since that report was published, there have been a series of global and local political changes reshaping the political and economic landscape in ways yet to be clear. This has only increased the focus on the role cities play in addressing some of the biggest challenges facing the country and its communities. In parallel, the momentum behind the development of smart or future cities continues to grow as UK cities look to exploit technology to address their social, economic, and environmental challenges. This interest in technology is accompanied by programmes for innovation in governance and process that will embed innovation at the heart of city policy.

The commitment of UK cities to innovation and service improvement is reflected in the expansion of this report to cover 20 cities at various stages of maturity in the development and execution of their smart city vision.

1.2 Emerging Trends

The momentum behind smart cities is reflected in a growing understanding of what is required to accelerate the adoption of digital technologies. The research for this report identifies five key developments:

- **Bridging the gap between smart city programmes and strategic city priorities:** Cities are building the links that will embed digital innovation in frontline services.
- **Supporting the emergence of city platforms:** More cohesive strategies are being developed for the deployment of new technologies, including big data analytics and citywide Internet of Things (IoT) solutions.
- **Strengthening regional perspectives:** As the extended scope of smart cities is recognised, smart city programmes are developing collaboration networks across combined authorities, county authorities, and regional agencies.
- **Expanding the partner ecosystems needed to deliver a smart city vision:** The increasingly important role that local universities are playing in shaping and developing urban innovation programs is one notable development.
- **Developing more integrated approaches to city issues:** A growing number of projects recognise the interconnection between transport, health, energy, and housing, for example, and the need to assess the impact of innovations across these traditional siloes.

These positive developments are also leading to fresh assessments of the challenges facing cities. The impact of austerity measures and cuts in local government spending continue to be an important factor in shaping city policies, priorities, and the ability to adopt technical and organisational innovations. However, the most commonly cited challenges to the adoption of new approaches and new technologies are the ability and the appetite of local government to accept and manage the risk associated with innovation – in terms of the financial, organisational, cultural, and technical barriers presented.

"LEADING CITIES ARE BRIDGING THE GAP BETWEEN INNOVATION PROGRAMS AND FRONT-LINE SERVICE PRIORITIES."

1.3 Background to the Report

1.3.1 Aims of This Study

The aim of the UK Smart Cities Index is to provide an assessment of the current state of smart city development in the UK through a detailed comparison of the 20 leading smart cities. The evaluation highlights their strategies, key projects, and overall readiness to develop smart city visions. The study also highlights lessons to be learnt from early adopters and areas where cities, the national government, and other stakeholders need to act to accelerate smart city development in the UK.

1.3.2 Evaluation Method

The 20 cities were selected on the breadth and depth of their smart or future city strategy and specific programmes in areas such as digital innovation, social care, urban mobility, energy, education, and sustainability. The assessment also looks at the extent of their partnerships and collaboration with other agencies and the private sector. A detailed comparison was made of the top 20 cities to identify the current leaders and their closest challengers.

The evaluations in this report are based on Navigant Research's corpus of smart city research; public documents on city strategies, projects, and performance; interviews with city leaders and project teams; and interviews with other key stakeholders in the development of smart cities from the public and private sector.

1.3.3 Evaluation Criteria

The city evaluations for this Index are based on two dimensions: Strategy and Execution. The Strategy dimension assesses each city's vision, goals, and objectives as they relate to its smart city programme. The Execution dimension assesses the city's actual achievements, from initial projects to full-blown deployment of innovative technologies and services.

Each dimension is split into five evaluation categories. The evaluation categories for the Strategy dimension are:

- **Vision:** Assesses the clarity, comprehensiveness, and depth of the city's smart or future city strategy.
- **Digital Innovation:** Evaluates a city's strategy to develop and exploit digital technologies and services.
- **Service Innovation:** Examines a city's strategy for innovations in local services that exploit improvements offered by smart technologies.
- **Sustainability Plans:** Assesses a city's sustainability strategy and the explicit targets set for energy consumption, greenhouse gas emissions, and related goals.
- **Stakeholder Engagement:** Examines the range of city stakeholders involved in the development of the smart city strategy.

The evaluation categories for the Execution dimension are:

- **Implementation:** Assesses the city's overall progress in translating its strategy into action based on the number, range, and extent of projects implemented to date.
- **Digital Delivery:** Evaluates progress on implementing the city's digital strategy, including pilot projects, smart city demonstrators, and full-scale projects.
- **Service Delivery:** Evaluates progress on implementing service innovations defined in the city's smart city strategy.
- **Environmental Impact:** Looks at achievements against sustainability targets and implemented environmental and sustainability programmes.
- **Community Reach:** Assesses engagement across multiple communities and stakeholders and the extension of projects into the wider city region.

Navigant Research scores the cities in the UK Smart Cities Index according to four categories; Leaders, Contenders, Challengers, and Followers:

Leaders

These cities have differentiated themselves through the clarity, breadth, and inclusiveness of their smart city vision and planning. They are also leading the way in implementing significant projects at both the pilot and increasingly full-scale levels.

Contenders

These cities have done much to establish their smart city strategies and have implemented some significant projects. However, there are still some gaps in their strategies, and the number of actual projects may fall behind that of the smart city Leaders.

Challengers

Challenger cities have laid down a vision for their smart city endeavours and have begun to deploy projects, but execution still trails the vision outlined. They may have shown strong initiative in a few key areas but with less breadth in their programme than the leading cities.

Followers

These are cities that are beginning their smart city journeys. They may have made initial statements of intent and begun limited pilot projects and siloed operations, but they need to develop a more integrated view for city development and/or stronger leadership for their programmes.

1.4 The UK Smart Cities Index

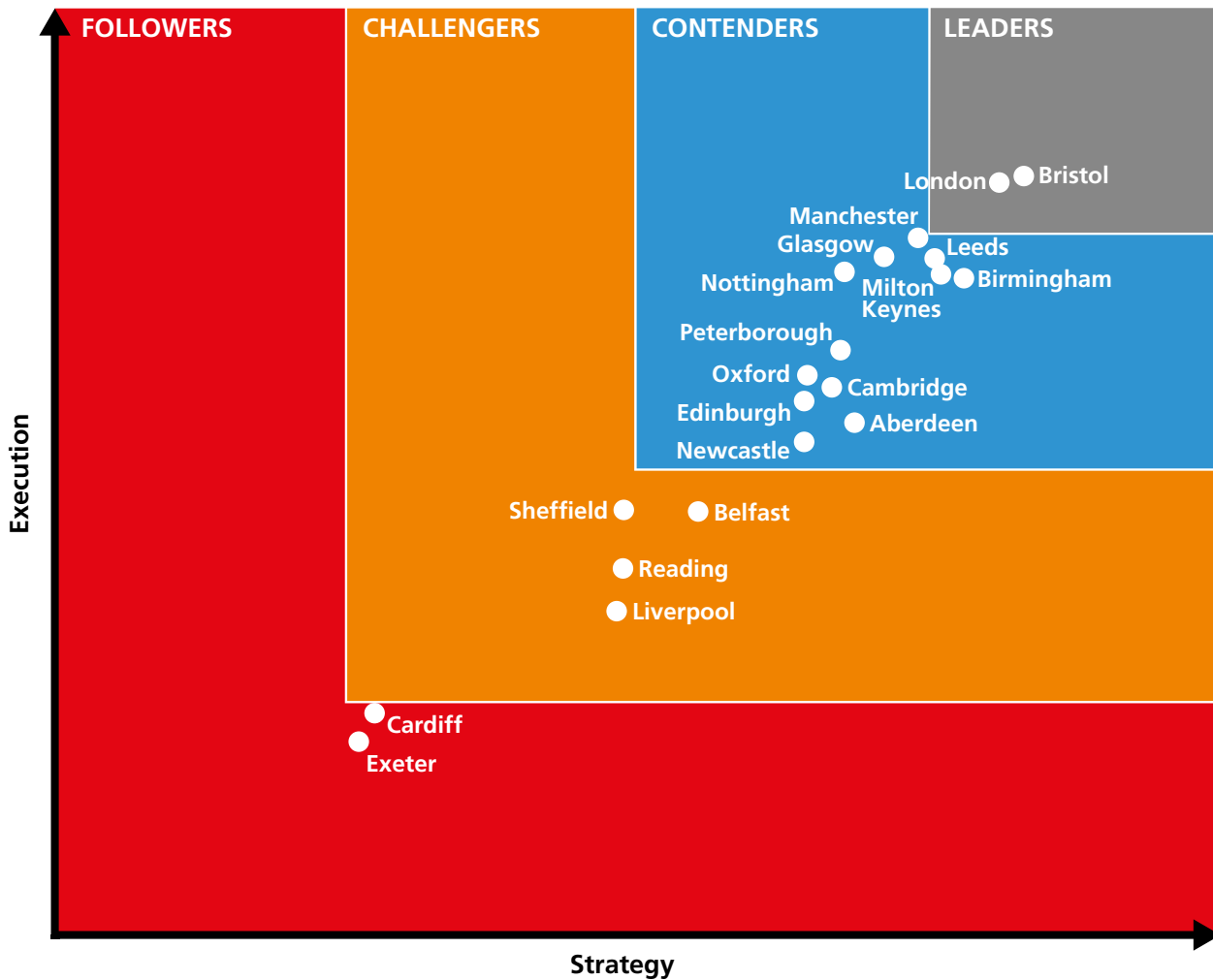
1.4.1 Summary of Rankings

Bristol and London retain the Leader positions in this new assessment. Both cities are building on their existing programs and working hard to embed innovation across city operations, infrastructure, and service delivery. However, Bristol has edged ahead to take the top position, largely because of the strong momentum it has shown over the last 12 months.

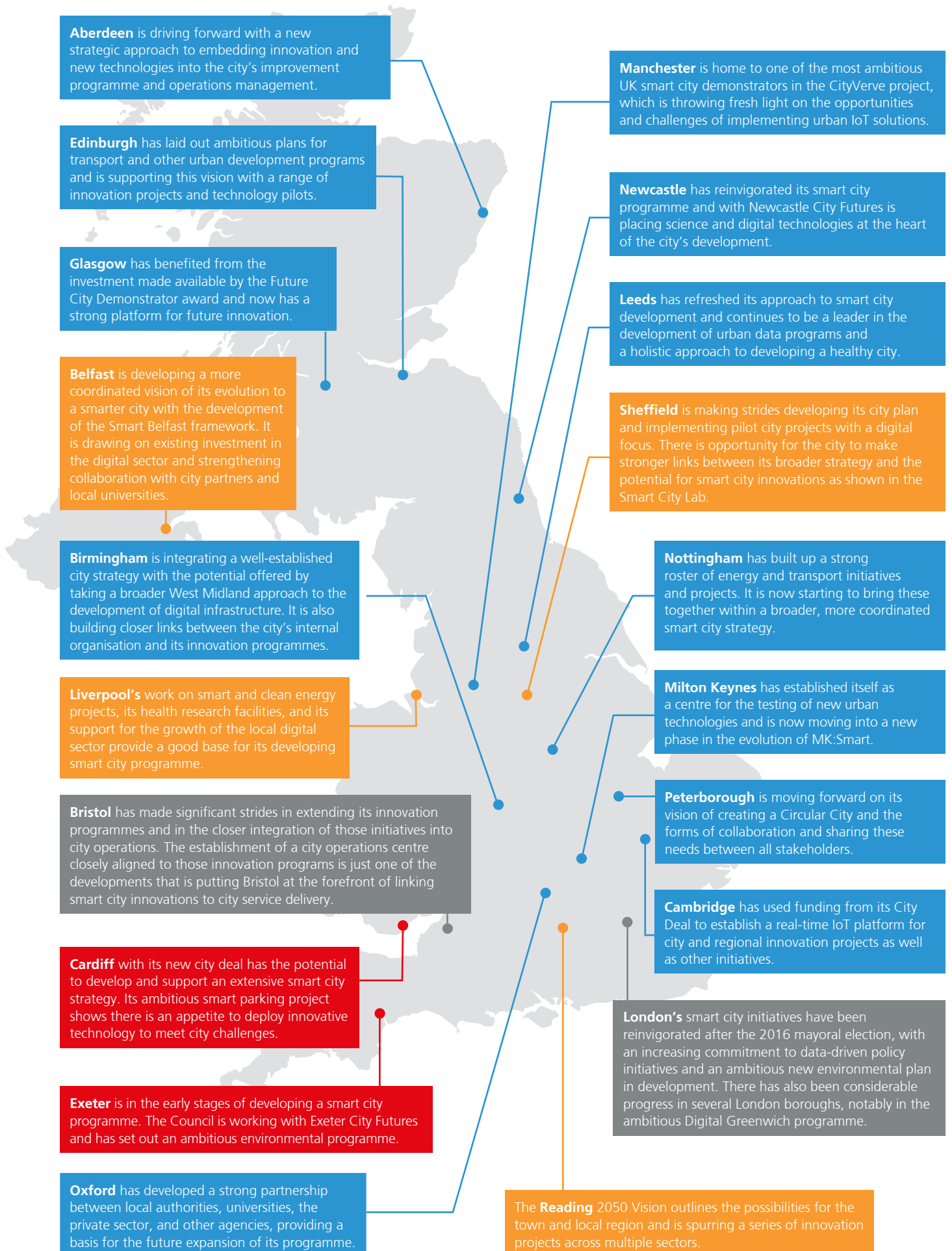
While Bristol and London retain the Leader positions, the Contender cities are also making significant progress, creating a strong cadre of UK cities that are putting digital innovation at the heart of urban development. The diversity of approaches among these cities is also producing a wealth of insights on both organisational and technological innovation.

The other cities assessed are at an earlier stage in their smart city journey, but are establishing their strategies and building on initial projects and initiatives. These cities have great potential to accelerate their programmes during the next 12 months.

Chart 1.1 - UK Smart Cities Index 2017



(Source: Navigant Research)








1.5 Insights for City Leaders

1.5.1 Lessons from the Leading Cities

Although each city needs to define a smart city strategy that matches its own circumstances, some common elements can be identified from the experience of the early leaders – in the UK and internationally. Five key building blocks are summarised in Figure 1.1.

Figure 1.1 - The Building Blocks for Smart City Programmes

Key to Success	Leading Practices
 <p>Strong leadership from city leaders and executives is vital to develop a coherent and sustainable smart city strategy</p>	<ul style="list-style-type: none"> Guiding vision statement, roadmaps Public / private working groups Linking innovation to city priorities
 <p>Building on existing priorities and assets to develop a distinct smart city vision that is aligned with local needs and goals</p>	<ul style="list-style-type: none"> Building on existing skills and resources Aligned with economic development Embed digital view in capital projects
 <p>Work with local communities in all aspects, from initial strategy to project design, deployment, and data collection</p>	<ul style="list-style-type: none"> Emphasize co-creation of services Extend digital inclusion programs Demo programs as blueprints for scale
 <p>Bring together public sector agencies, the private sector, and academia to form a network of partnerships</p>	<ul style="list-style-type: none"> Develop innovative approach to public-private sector partnerships Closer collaboration with universities
 <p>Focus on innovative uses of ubiquitous data for policy development and the creation of new services</p>	<ul style="list-style-type: none"> Evolving open data strategies Building platforms for IoT data Exploring the use of advanced analytics

(Source: Navigant Research)

1.5.2 Key Trends and New Approaches

In addition to leading practices, the research for this report identified several emerging trends as cities gain better understanding of their needs and how to exploit new technologies to better advantage:

1.5.2.1 Building Bridges between Innovation and Operations

The leading cities have laid strong foundations for the development of innovation – both technically (in terms of test beds and platforms) and culturally (in terms of a trusted ecosystem of partners). The challenge now is to integrate this innovation culture with the day-to-day operations of the city. These cities are strengthening the links between innovation teams and city departments. Pilots and demonstrations are also being more closely aligned to city strategies and priorities. Closer collaboration is also developing between smart city or digital innovation teams and internal information and communications technology (ICT) functions, linking digital innovation agendas and the digitisation of backend city operations. At the same time, smart city programmes are going beyond initial seed funding to becoming an established element in city organisations, with stronger long-term governance and financing models.

1.5.2.2 Developing City Platforms

Cities are developing more cohesive strategies for the deployment of new technologies, in particular, they are taking a more strategic view on the future deployment of IoT technologies and the necessary communications infrastructure. These cities have deployed or are planning large-scale deployments of low power networks, are vying to be test beds for 5G technologies, and are looking at future fibre needs to support these ambitions. They are moving beyond broadband programs for public buildings and Wi-Fi in the city centre to look at access requirements across the city, including less affluent and digitally excluded communities.

1.5.2.3 The Regional Dimension

The unbounded nature of smart cities is becoming widely recognised as smart city programs branch out to include a diverse group of local authorities and agencies – whether embracing new combined authorities or broader county-based programs. This approach enables closer integration across a range of services for larger cities and new combined authorities and offers the benefits of scale when applying for funding or tendering for new services or solutions. It also enables smaller cities and towns to find greater scale in their programs as well as recognising the close relationship between a city and its local regions in areas such as economic development and travel infrastructure.

1.5.2.4 Extending City Partnerships

There is a strong desire among city leaders to build more public-private sector partnerships. One of the most notable developments in this regard is the increasingly close relationships that smart city programmes are developing with local universities. Universities are not only providing research support but also are often active players in defining projects, securing funding, defining strategies, and contributing to or providing leadership of programmes. This is proving to be a win-win relationship as universities can show the effects of their work, gain access to real-world big datasets, and build closer bonds with local communities and decision makers.

1.5.2.5 A Holistic View on City Challenges

The opportunity to take a more holistic view of city challenges is one of the foundational concepts of the smart city movement. However, it is much harder to achieve in practice. The leading UK cities are now taking their experience with diverse pilot projects to develop approaches that embed such a perspective in the design of programs, in the scoping of projects, and the measurement of benefits. Some cities, for example, are looking at the idea of smart districts or communities where the interconnection between transport, health, energy, housing issues, and innovations can be tested at scale. The work that the Future Cities Catapult is coordinating on Smart Planning can also help support a process that gives more consideration to interconnected dependencies in city design.

1.6 Highlighting Innovation

Table 1.1 - Innovation Highlights 2017

Innovation Area	Star Award 2017	Highlights	Commended Cities
Transport	Milton Keynes	An extensive programme of technical innovation spanning all aspects of mobility and tied to the long term strategy for the city.	London, Oxford, Nottingham
Health	Leeds	An integrated cross sector approach to health and aging issues, implemented solutions, and extensive pilots; supported by a strong focus on the value of data.	Birmingham, Nottingham, Manchester
Education	Newcastle	Newcastle University is taking a leading role in developing the city's innovation programme to support improved citizen services and economic development goals.	Bristol, Cambridge, Oxford
Energy	Nottingham	A pioneer in new approaches to city energy, it has put down a strong foundation and is now developing an impressive roster of community energy projects.	Aberdeen, Bristol, Liverpool, London
Safety	Glasgow	A state of the art operations centre for city management and citizen engagement; the city is also developing a resilient city programme.	Bristol, Oxford
Sustainability	Peterborough	A leader in environmental programmes and circular economy innovations, including the Share Peterborough platform.	Bristol, Manchester, Oxford
Internet of Things	Bristol	A unique environment for IoT testing, an extensive partnership ecosystem, and established pathways for scaling successful projects.	Cambridge, Manchester, Milton Keynes
Data and Analytics	London	Continues to push the boundaries on the use of data to improve city services and priority outcomes, reinforced by the recent appointment of a Chief Data Office.	Birmingham, Bristol, Leeds, Milton Keynes
Strategy	Aberdeen	A new operating model for the city aims to embed smart city goals into design and operation of city services.	Birmingham, Bristol, Milton Keynes, London
City Partner	Future Cities Catapult	An important catalyst for smart city innovation, including work on Smart Planning projects, the Cities Standards Institute, and programme support for cities.	Smart Cities Scotland, Innovate UK

Source: Navigant Research

The UK Smart Cities Index provides an assessment of the overall progress of UK cities in their exploitation of smart technologies. However, it is also important to highlight specific developments across cities that are moving the bar in areas such as transport, health, and digital platforms. Table 1.1 highlights the cities that are leading the way in some critical areas. The Star Award reflects a particularly impressive range of innovations tied to a coherent strategy for further development. Competition is tough in all these categories and other cities that are close contenders are mentioned and deserve praise.



Transport

Transport projects are the most common areas of focus for cities.



Health

Cities are focused on improving health outcomes for all their residents.

1.6.1 Transport

Transport projects are the most common areas of focus for cities. Improvement in transport infrastructure and services have a major impact on economic development, social inclusion, air quality, and emissions reduction. Smart cities are looking at a range of issues and solutions including intelligent traffic management, mobility apps, sensor networks, EVs, hydrogen buses, AVs, congestion, and the impact of traffic on air quality issues.

Notable developments include:

- **Milton Keynes** has led a diverse range of transport initiatives spanning mobility apps, EV and AVs, and a new intelligent traffic light management system.
- **Nottingham** has a long-standing clean transport policy that spans its work on local transit improvements and low carbon vehicles.
- **Transport for London** has been a leader in the sharing of data and the use of analytics; and London remains the leader in congestion charging and integrated ticketing. Greenwich is also establishing itself as a hub for transport innovation.

Other notable initiatives include several transport innovation projects in Oxford, Edinburgh's ambitious transport plan, and Cambridge's work on real-time information services and an integrated transport programme. Cardiff's citywide smart parking initiative is also worth noting.

1.6.2 Health

Cities are focused on improving health outcomes for all their residents. Support for an aging population and reduction in health inequalities, notably in terms of differences in life expectation between communities, are high priorities.

Air quality is also high on the agenda for many cities as its effect on health becomes increasingly evident. The leading cities are developing relationships across care providers, including commissioning groups, NHS trust, academia, and social care providers. However, compared to transport, health and care systems are much more complex, involve many more agencies and suppliers, and have even more critical outcomes.

Notable developments include:

- **Leeds** continues to be a leader in exploring the possibilities of more integrated approaches to health and social care; the role of technologies in supporting people throughout their lives, and the importance of data in improving health outcomes.
- **Birmingham, Manchester, and Nottingham** are among the cities looking at the intersection of health issues with transport, housing, and energy. This is enabling a more holistic view on the development of smart and healthy communities.
- **Oxford and Cambridge** are working with academic health bodies to develop new approaches to health programs that connect with wider smart city initiatives.



Education and Learning Cities

One of the significant trends is the close relationship developing between local government and the university sector.



Energy

Energy is becoming an increasingly important issue for many cities.

1.6.3 Education and Learning Cities

One of the significant trends identified in this study is the close relationship developing between local government and the university sector. All the cities covered in this study are working with universities to some degree to progress their smart city strategy, but a number stand out for the depth of the relationship and its impact on innovation programmes.

Notable examples include the following:

- **Newcastle**, where the University of Newcastle has taken a leading role in the establishment of Newcastle City Futures and in directing and supporting a range of innovation programs in the city – as well as the establishment of the Science Central facility.
- **Oxford** and **Cambridge**, which are building on the resources of their world-renowned universities to develop closer relationships between academia and local communities and councils – to the benefit of both sides.
- **Bristol**, which established Bristol Is Open as a JV between the city council and Bristol University – and which is using the university's computing resources to underpin its smart city platform.

Other important partnerships include Milton Keynes with the Open University, Birmingham with the University of Birmingham and Aston University, Manchester's work with its universities around the Manchester Corridor, and Leeds council's work with the Leeds Data Institute.

1.6.4 Energy

Not only is energy policy a key element in any broader sustainability targets, it is also closely connected to transport, housing, and health policies. The new energy sector is also seen as an important economic growth area for many cities.

Among the cities leading innovation in urban energy programmes are:

- **Nottingham** is building on its foundational energy innovation projects with new community energy schemes that include solar and storage programs. It is also looking at how energy improvements interact with transport and housing issues.
- **Bristol** has been another leader in the establishment of a city energy company and is also examining the intersection of energy with other areas such as transport and housing.
- **London** is developing and testing a sustainable energy management system as part of the Sharing Cities project based in Greenwich.
- **Liverpool** has been targeting energy efficiency, emissions reduction, and fuel poverty as part of a diverse programme that includes energy management for city buildings and the establishment of a city energy company.



Public Safety and Resilience

Public safety is a prime concern for all cities.



Sustainability

Many cities have set out ambitious plans to improve sustainability.

1.6.5 Public Safety and Resilience

Public safety is a prime concern for all cities. Because of the criticality of these functions they are not generally a focal point for innovation programs – with research being done through other organisations, often at a national level.

The fact that most UK cities have already deployed extensive closed-circuit TV (CCTV) systems indicates the focus is now on coordination and the better use of video analysis and other forms of analytics. Some cities have established city operation centres to coordinate traffic and other city monitoring capabilities, most notably Glasgow with its state-of-the-art development. Bristol's new city operations centre is also becoming the hub for the management of all city services.

A growing area of interest is the preparation of the city for the impact of climate change and extreme weather events. Oxford and Peterborough, for example, are both using sensor networks for flood detection.

1.6.6 Sustainability

Many cities have set out ambitious plans to improve sustainability. This has not only driven a range of innovative programs for energy efficiency, but also new approaches for resource management, including a developing interest in the circular economy.

Notable examples include:

- **Peterborough** and **Bristol** have both established widely recognised environmental programs, which are embedding energy and environmental innovations in city services.
- **Low Carbon Oxford** is bringing together a broad range of partners to meet city and regional environmental goals.
- **Manchester** has declared that it will be a zero-carbon city by 2050 in response to the global requirements defined in the Paris Agreement on climate change.



Internet of Things

Leading cities are moving beyond a series of small IoT trials.



Data and Analytics

The rapid growth in the number of sensors and other intelligent devices is creating an immense amount of new data.

1.6.7 IoT

Leading cities are moving beyond a series of small IoT trials. First, they are looking closely at how they can quickly scale successful projects so that they make a real impact on the quality of life offered by the city. Secondly, they are looking to establish a testbed environment that can support a rolling programme of innovation projects.

Leading examples include:

- **Bristol Is Open** has established a unique environment for solution testing, but Bristol has also made a significant effort to embed those projects in the wider city strategy.
- **Manchester** has a great opportunity with CityVerve to establish itself as a leader in IoT innovation.
- **Milton Keynes** is moving into a new project phase that will build on the IoT foundations laid out over the last 3 years.
- **Cambridge** is also notable for the establishment of a LoRa network for the city in collaboration with the University of Cambridge.

1.6.8 Data and Analytics

The rapid growth in the number of sensors and other intelligent devices deployed across the city landscape is creating an immense amount of new data that cities need to manage and learn to exploit to the benefit of all. All the cities included in this report are looking at how to use data to improve services and boost innovation.

Notable developments include:

- **London** has established the London Office of Data Analytics (LODA) and appointed a Chief Data Officer to help accelerate the use of data to improve services across the capital.
- **Leeds** has been a leader in open data for several years, with Data Mill North just one of several data-focused initiatives in the city, including the Leeds Institute for Data Analytics at the University of Leeds.
- **Bristol** has upgraded its open data platform and is looking at closer integration with the new City Operations Centre. It has also created the Bristol Data Dome to demonstrate the value of city data.



Strategy

Cities must rethink the way they design, manage, and operate services in the digital age to successfully adopt new technologies.



City Partners

Even the leading cities need support to keep pace with the rapid evolution of technologies.

1.6.9 Strategy

The successful adoption of new technologies to improve city services requires cities to rethink the way they design, manage, and operate city services in the digital age. Leading cities are taking a fresh view on the impact of technology on city policy making, planning, and service design.

Innovative approaches include:

- **Aberdeen** has committed to a new Target Operating Model, which seeks to embed smart city thinking into city planning, service design, and infrastructure investment. This will be enabled by new approaches to the provision of digital infrastructure and services.
- **Birmingham** is now evolving its extensive strategic programme to accommodate the new possibilities offered by the newly combined authority and the regional perspectives that supports.
- **Bristol** and **Milton Keynes** are among the cities that are evolving their strategy to ensure closer links between innovation programmes focused on smart city technologies and the city's operational teams.
- **London** is developing the London Office of Technology and Innovation, which aims to embed innovation deeper into operations across the GLA and London boroughs.

1.6.10 City Partners

While the number of smart city programmes in the UK continues to expand, there are still many cities that are still at the beginning of their journey. Even the leading cities need support to keep pace with the rapid evolution of technologies such as 5G networks, machine learning, and automated vehicles, for example. Cities need partners at national level, in academia, and in the private sector to help them navigate this changing landscape.

- **The Future Cities Catapult** is having a strong influence across the country, helping cities initiate smart city programmes, share ideas and insight, develop common standards, and accelerate innovation in areas like Smart Planning.
- **Innovate UK's** support for innovation projects has been important in kick-starting smart city projects in many cities and continues to be an important source of funding and a catalyst for change.
- **The Scottish Cities Alliance** has instigated the Scottish Smart Cities initiative (also called the 8th City programme) to help build on the momentum of smart city development in Scotland generated by Glasgow's Future Cities Demonstrator.

1.7 The Evolving Role of Central Government

The continuing move towards the devolution of power and responsibility from central government to cities and regions is one of the most important influences shaping the development of city agendas, including their smart city ambitions. However, there continues to be an important role for UK government in the development of smarter cities across the country. This is demonstrated in the importance of the Future Cities Catapult and Innovate UK to the development of smart cities across the UK. Ensuring that the national digital infrastructure is adequate for the challenges of the future, must continue to be a responsibility of government (as reflected in the UK Digital Strategy and National Infrastructure Delivery Plan). There are three areas where central government can play a significant role, even within a model that emphasises devolution.

“THE BIGGEST CHALLENGE FOR SMART CITY INITIATIVES IS TO OVERCOME THE WELL-FOUNDED RISK AVERSITY OF LOCAL GOVERNMENT.”

1.7.1.1 Underwriting Risk

One of the most common requirements of smart city teams from central government is support in helping cities accept and manage the greater risk involved in the large-scale adoption of new technologies or innovations in service design and delivery.

There is still a need to bridge the gap between funding for demonstration projects and full-scale commercial deployments. It is still not clear how funding for pilot projects can evolve into support for the broader adoption of smart city technologies.

Central government and its agencies should work with cities – and suppliers – to examine means for reducing, sharing, and managing the risks involved. This should encompass the funding burden of testing new solutions at scale, but also the means for balancing the risks against the potential benefits for all.

Suppliers are also frustrated at the gap between pilot projects and the move to commercially sustainable models. There is an ongoing need to facilitate engagement between cities and suppliers and cross-industry groups like SmarterUK to explore how they can better manage the risks associated with large-scale deployments.

1.7.1.2 Addressing Procurement Issues

The debate continues as to how public sector procurement can be better designed to accommodate innovation, new technologies, and outcome-based approaches. This is not an issue restricted to the UK, similar challenges face cities across Europe and in other parts of the world. Whilst there is no easy solution to this challenge, there are some promising signs. Some cities, for example, are exploring the use of the Small Business Research Initiative (SBRI) model developed by UK government to encourage the involvement of small to medium enterprises (SMEs) and others in research-based solutions to public sector challenges.

1.7.1.3 Supporting Collaboration

Devolution is already enhancing collaboration networks at a regional level. Other collaborative networks are also evolving; however, there still appears to be room for structured national programs for sharing insights and resources.

Future Cities Catapult (and other Catapults) are making considerable efforts to address this. Programmes to support the use of AVs and the establishment of 5G test beds seem to be well coordinated. The work on Smart Planning was also commonly referenced as touching critical issues in smart city development. However, it is less clear that there are good structures for sharing development around city IoT developments. It is important that insights from projects like the Glasgow Future City Demonstrator and the current CityVerve project are shared and that city-led initiatives like MK:Smart, for example, are understood and valued by central government as a national resource. Where cities are addressing issues in parallel – as with air quality monitoring and management at present – a common directory of initiatives could be a useful resource.



SECTION 2

DEVELOPMENTS IN THE UK SMART CITY LANDSCAPE

2.1 The Evolution of the Smart City

The smart city concept embraces some of the most critical challenges facing global society today, as well as a range of innovative technologies that present potential solutions. The smart city is a simple label for the complex forces shaping urban life in the 21st century.

In Navigant Research's definition:

"A SMART CITY IS CHARACTERISED BY THE INTEGRATION OF TECHNOLOGY INTO A STRATEGIC APPROACH TO SUSTAINABILITY, CITIZEN WELL-BEING, AND ECONOMIC DEVELOPMENT."

The drivers behind the continued interest in smart cities include the continued growth in urbanisation, the need to reduce city emissions and better manage resource consumption, and growing economic, financial, and environmental pressures. These developments are entangled with rapid technology development in complex ways that present many opportunities for cities and suppliers.

The growing adoption of Internet of Things (IoT) technologies and the decreasing cost of sensors and connectivity services are driving the wider deployment of smart devices, which further enriches the data available to users and managers of city services. Even without strong drivers for efficiency and sustainability, the city landscape would be in a process of transformation as it becomes as much a virtual environment as a physical one.

2.2 Smart Cities in the UK

The movement towards smarter cities is firmly established in the UK. Many cities have long-standing strategies to focus on digital innovation, clean technologies, and service innovation in transport or health, for example, which provides a sound basis for broader smart city programmes. Central government initiatives have played an important part, notably in the £24 million Glasgow Future Cities Demonstrator, which catalysed many cities to develop smart city initiatives. Similarly, the 2016 IoT Challenge awarded to Manchester CityVerve galvanised a number of significant collaborations, not just in the winning city.

The development of smart cities in the UK is closely connected to the continuing (and never-ending) debate over the relationship between the largest cities and the central government. In recent years, this has focused on the potential of the so-called Northern Powerhouse, based on greater devolution for the larger cities of northern England. This debate has now extended to other regions including the Midlands, with the Midlands Engine as a mirror the Northern Powerhouse, and the West Country (which now has a combined authority under a newly elected mayor). The recently elected mayors for combined authorities in city regions, including Liverpool, Birmingham, and Manchester, are already having an impact on the shape and scope of smart city programmes in those areas. Similarly, the election of a new mayor for London has led to a reinvigoration of the capital's strategy to support the mayor's goal of making London the smartest city in the world. Cities that have not chosen to have elected mayors, such as Newcastle, are no less affected as they look to counterbalance the strengths of their approaches and chosen route. Across different structures, city deals have been an important catalyst not only in releasing funds for infrastructure investment but also enabling more joined-up thinking across issues like transportation, housing, and economic development. Scotland has also established its own collaborative programme with Smart Cities Scotland, a work stream under the Scottish Smart Cities Alliance spanning the seven largest Scottish cities.

These developments continue to take place under the shadow of tough and continuing cuts in city budgets, which is forcing city leaders to continuously examine all aspects of city operations in the search for increased efficiency and cost savings. Added to this are the uncertainties created by Brexit – with concerns already arising over future innovation funding and skills shortages.

The UK has also been a leader in smart cities standards, beginning with the launch of the smart city framework in February 2014, developed under the aegis of the British Standards Institution with support from cities, governments, and suppliers. The Smart City Framework – Guide to Establishing Strategies for Smart Cities and Communities has been followed by specific studies to provide support in areas such as interoperability and data sharing and by the creation of the City Standards Institute within the Future Cities Catapult. The latest publication, PAS 184 Smart cities – Developing Project Proposals for Delivering Smart City Solutions, provides guidance on addressing some of the key challenges highlighted in this study, including the scoping of smart solutions, the need to overcome risk aversion, procurement practices, and benefits measurement.

2.3 Assessing the State of Smart Cities in the UK

The UK Smart Cities Index provides a snapshot of the development of smart city programmes across the leading cities in 2017. Detailed assessments are provided in Section 4, but some general trends are apparent across the evaluation criteria.

2.3.1 Developments in Strategy and Leadership

When establishing a smart city strategy, clear objectives and strong leadership teams are an important basis for most smart city programs. Many of the cities included in this assessment for the first time have made important advances by extending or strengthening their smart city leadership and overall framework. On the other hand, for those cities that are lagging in the Index, there is still work to be done to establish more robust governance models and more coherent overarching vision for their programs.

One of the most interesting developments in more advanced cities is a focus on strengthening links with the city's broader social and economic targets, and building links with the city leadership team, IT departments, and frontline departments. Aberdeen, for example, is implementing an impressive new approach based around its target operating model. Birmingham – a leader in defining an inclusive smart city strategy – is now looking afresh at the implication of taking a broader regional approach, closely aligned to the strategy of the new combined authority and its elected mayor. Bristol, Cambridge, Leeds, Oxford, and Milton Keynes are also among the cities strengthening the links between smart city projects and city management. London's recent appointment of Chief Data Officer and a new CIO role in Birmingham City Council are also indicators of the need for senior advocates for change within city leadership structures.

2.3.2 Digital Innovation

Digital innovation combines the development of city strategies for IT and communications technologies and specific projects to understand the opportunities they offer for improving city services through pilots and demonstration projects. There are now several cities with extensive test beds for new solutions, including established networks in Bristol and Milton Keynes, Manchester with CityVerve, and new networks in Cambridge and Greenwich. Cities like Aberdeen and Birmingham are also looking ahead at their strategic requirements. Leading cities are looking to go beyond initial investments in Wi-Fi in city centres and public buildings to broader strategies that support future IoT projects and other disruptive innovations such as automated vehicles (AVs) and the emergence of 5G networks.

Cities continue to see data platforms as a key element in their strategy, although there is still some way to go to realise the more ambitious plans for data exchange. London has led the way with the London Datastore, and with its newly appointed Chief Digital Officer (CDO) can be expected to continue to be a leader with programmes such as the London Office of Data Analytics. Several cities have put in place shared data platforms including Bristol, Manchester, Milton Keynes, and Cambridge – which provide an important foundation for future developments.

It is important that cities ensure that all sections of the community benefit from smart city solutions. The cities covered in this report have programmes to address digital exclusion through training and active engagement. Many are developing co-creation programmes to involve residents and small businesses in the design of new services and the application of new technologies.

2.3.3 Service Innovation

One of the fundamental reasons for investing in smart city technologies is to deliver better and more efficient services. This means that digital innovation should be matched with service innovation. These new approaches span all aspects of city operations, including the use of telehealth and telecare to support social services, smart parking to reduce congestion, intelligent street lighting to reduce energy costs, and information services that allow residents and local businesses to be more involved in shaping their cities.

City transport is an area of focus for all the cities covered in this report, with investments being made in changing mobility patterns, upgrading infrastructure, and exploring the impact of new technologies. Aberdeen, Cambridge, Edinburgh, Milton Keynes, and Nottingham are among the cities working on a range of transport initiatives. London has led the way with several groundbreaking investments, including congestion charging, a unified payment card, smart parking, bikesharing, and access to extensive transport data. Many of these are coming together in the projects supported by Digital Greenwich. Cardiff meanwhile is deploying a citywide smart parking system.

In health innovation, Leeds is leading the way, working closely with local and national NHS organisations. Its ambition to be the best place to grow old in the UK is driving several large-scale projects that look at the impact of technologies on services for older residents. Liverpool has also made health a key focus area, exemplified by a new innovation centre at Alder Hey Children's Hospital.

2.3.4 Sustainability

UK cities have set a range of ambitious targets to reduce their carbon emissions and improve their use of resources. Most cities are committed to meeting the national goal of an 80% reduction in carbon emissions by 2050, but there is considerable variation in their short- and medium-term targets.

Bristol has established its international credentials as the European Green Capital in 2015, and Peterborough continues with a strong focus on establishing itself as the UK's Environment Capital. Nottingham is a leader in smart energy projects but Bristol, Liverpool, and London are also notable for their efforts to take more control over local energy production and consumption as part of their carbon reduction programs. London has also released an ambitious new environmental strategy for consultation. Manchester and Birmingham are among the cities also looking at new city energy ventures.

Peterborough's strategy for the creation of a Circular City is being supported through a collaboration platform that links local businesses and communities to improve energy efficiency, reduce resource consumption, and help boost the local economy.

Air quality is one of the issues that is being given greater priority in many cities. Several air quality monitoring projects have been deployed (notably in Cambridge and Leeds) – and cities are looking at congestion improvements, shifts to mobility patterns using better information services, and the accelerated adoption of low carbon vehicles.

2.3.5 New Partnerships

An important facet of city strategies is the extension of their partnership arrangements with both the public and private sectors. Close relationships with academia are a notable attribute of most smart city programmes. Bristol, for example, is making use of Bristol University's supercomputing facilities as well as relying on it to help manage its new experimental communications network. Milton Keynes has forged a close relationship with The Open University, which is playing a lead role in MK:Smart. Newcastle University has played a lead role in establishing Newcastle City Futures. Leeds University is also closely aligned with the city's strong emphasis on the value of urban data and analytics.

2.4 Challenges and Barriers

Whilst the leading cities have some impressive success stories, smart city developments are still relatively immature. There are several issues that both the leading cities and those following them need to face.



2.4.1 Moving Beyond Pilots: Finance and Risk

Local authorities are working under extremely tight financial settlements and are expected to continue to do more with less over the coming years. This situation restricts the ability of cities to provide their own upfront funding for demonstration projects and makes the transition to commercial operations more difficult.

Smart city initiatives in the UK continue to rely heavily on innovation funding from the UK government agencies, research councils, and European regional infrastructure and R&D funding. Several programs have now evolved into more long-term support from city councils or through city deal programs. There are also closer links being established between smart city strategies and the policy goals and operational priorities of the city. However, there is still a significant gap between demonstration projects and implementation at scale.

The most significant challenge facing aspiring smart cities remains how to transition successful pilots into full-scale projects. This will require cities and their delivery partners to work together to look at funding sources for initial investment and to develop well-founded business cases. There is a growing realisation that pilots and demonstration projects need to be designed from the outset to be able to test and develop business cases and to measure real outcomes that will provide the basis for wider deployment. Shifting the focus to the delivered benefits should make the path from pilot to wider deployment clearer for those projects, and prove their worth.



2.4.2 Cultural Change

One of the successes of UK smart city initiatives is the strong ecosystems that are being built among a wide range of partners. The challenge now is to build the internal processes and targets that can reduce the barriers to the introduction of innovation. The long-standing issue of siloed working is being addressed by cities taking a more holistic approach that understand the links between transport, health, and housing policy.

One of the biggest challenges presented by a reduction in funding is in the lack of free resources in delivery departments able to work on innovation projects. Smart city and digital teams need experts in social care or transport, for example, who they can work with to deliver new solutions with long-term benefits. These resources can be hard to find when departments are already tightly squeezed for staff and time.



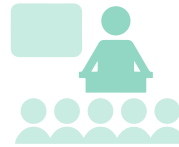
2.4.3 Improving Collaboration and Knowledge Sharing

Both formal (Core Cities, regional partnerships, the Scottish Cities Alliance) and informal collaboration is improving between cities. The Future Cities Catapult and other Catapults are playing an important role, not least through standards development. But there is still room for better knowledge sharing on common problems. For example, many cities are looking at how to better monitor and manage air quality, and there could be value in a directory of projects or ways of sharing early findings (e.g., on sensor design and standardisation). Some areas seem to be better coordinated – for example, the work on AVs and 5G testing – but others are more difficult with the diverse solutions and use case around IoT. It is hoped that more lessons will come out of CityVerve. Regional partnerships – through city deal arrangements, LEPs, new combined authorities, and other structures – are also improving coordination on integrated strategies, knowledge sharing, bidding for project funds, and procurement.



2.4.4 Digital Infrastructure

Cities are making important strides in deploying broadband communications, but there is still much to do. There is a strong appetite among cities to be at the forefront of 5G testing and to exploit the possibilities offered by low power networks. Cities will also benefit from the wider rollout of 4G networks, high speed fixed broadband services, and low power networks, but city leaders, central government, and the communications industry need to ensure that the right options are in place to further develop citywide infrastructure. Further work is also needed to ensure the accessibility of services to all residents and to small businesses.



2.4.5 Education and Understanding

The broad nature of the smart city concept can lead to misunderstanding and confusion. Smart city teams need to work with city leaders and managers to ensure a common understanding of the key objectives for any smart city programme, as well as the opportunities and challenges. The goal should be to embed the idea of smart capabilities into most major projects or service redesigns so that the city can benefit from both short- and long-term gains from a focus on data and connectivity.

Cities need to engage local communities in all aspects of their smart city programmes, from initial strategy to project design and deployment. The leading cities are developing new models to involve their communities with an emphasis on the co-creation of services and digital inclusion programmes that show the local value of better data and the benefits of smart technologies.

SECTION 3

SUMMARY OF THE ASSESSMENT

3.1 The UK Smart Cities Index

This study shows the continued desire among UK cities to be at the forefront in the development of smart cities able to prosper in the age of digital and low carbon technologies.

The extended scope of this report compared to the 2016 report reflects the continuing expansion of smart city interest across the UK. This range is also reflected in the diverse levels of maturity shown in the report, from cities that are competitive with global leaders to cities in the early stages of defining their smart city strategy.

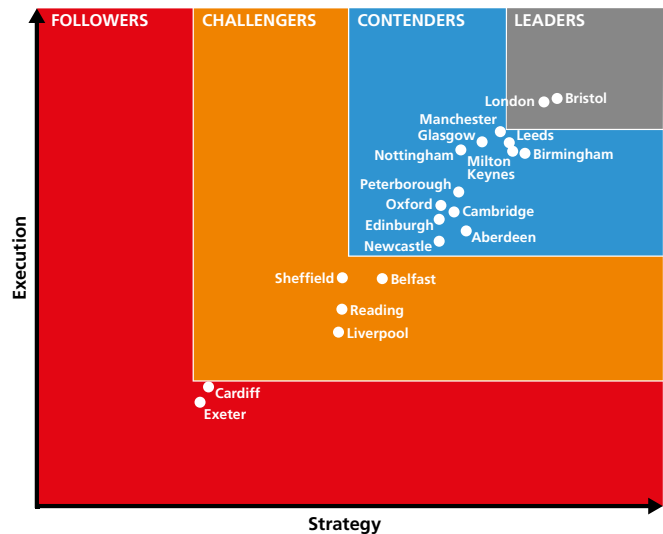
The leading cities are now building on their foundation programmes to create stronger links between innovation projects and core city strategies. This encompasses new city strategies, closer links to other city departments, integration with city IT and digital agendas, and stronger sponsorship from city leaders. Cities at an earlier stage in their development are establishing strategies and policies to direct their smart city initiatives and provide framework for their R&D projects and service innovations.

The technology landscape is also diverse. Cities are establishing platforms for innovation programmes and more integrated operational environments. IoT-based applications are becoming more widely deployed, as in the case of smart street lighting, but there are also a host of new technologies – the effects of which cities are grappling to understand – including AVs, 5G networks, and machine learning and other advanced data analytics.

This is also a period of change and uncertainty in the governance and function of UK cities. The impacts of devolution are still being worked through, and newly elected mayors are defining their programmes. Cities are also evolving their strategies to account for new regional implications and opportunities.

3.2 City Rankings

Chart 3.1 - UK Smart Cities Index 2017



Source: Navigant Research



3.2.1 The Leaders

Bristol and London retain the Leader positions in this new assessment. Bristol has edged ahead largely because of the strong momentum it has shown over the last 12 months across a range of initiatives. Both cities are building on existing programs and working hard to embed innovation across city operations, infrastructure, and service delivery.

- **Bristol** has made significant strides in extending its innovation programmes and in the closer integration of those initiatives into city operations. The establishment of a city operating centre closely aligned to those innovation programs is just one of the developments that is putting Bristol at the forefront of linking smart city innovations to city service delivery.
- **London's** smart city initiatives have been reinvigorated since the 2016 mayoral election, with strong commitments to smart city collaboration, increasing commitment to data-driven policy initiatives and an ambitious new environmental plan in development. There has also been considerable progress in several London boroughs, notably in the ambitious Digital Greenwich programme.



3.2.2 The Contenders

The strength of UK smart city development is represented by the strong group of Contender cities that have well-defined, evolving strategies and an impressive array of innovation projects. These cities are now building on well-established programmes, creating stronger bonds between different stakeholders and looking to accelerate the wider deployment of successful solutions.



3.2.3 The Challengers

The growing number of Challenger cities shows the breadth of interest in smart city development in the UK. The highest ranking cities are well-set to exploit the foundation work of recent years. Sheffield, Reading, Liverpool, and Belfast are all laying foundations and can be expected to make major strides in the coming year.



3.2.4 The Followers

Cardiff and Exeter have taken some important steps in their development as smart cities but there is still considerable work to be done in terms of developing a strategic programme and building the extensive ecosystem required to build an innovation environment.



SECTION 4

CITY ASSESSMENTS



Leaders

Bristol
London



Contenders

Manchester
Birmingham
Leeds
Milton Keynes
Glasgow
Nottingham
Peterborough
Cambridge
Oxford
Aberdeen
Edinburgh
Newcastle



Challengers

Belfast
Sheffield
Reading
Liverpool



Followers

Cardiff
Exeter

4.1.1 BRISTOL

4.1.1.1 Summary

Having established a strong strategic and technical basis for smart city development, Bristol is increasingly focused on the deployment of innovative, cross-cutting pilots and the integration of successful projects into city operations. The Bristol Is Open project provides a large-scale connectivity testbed for urban innovation, whilst the new City Operations Centre provides an evolving platform for the integration of existing and new services. Bristol also continues to lead the way in areas such as open data access, energy innovation, and community engagement.

Key areas of focus:



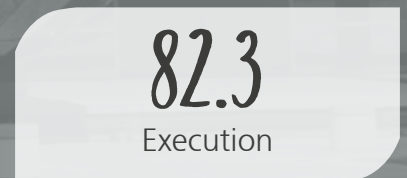
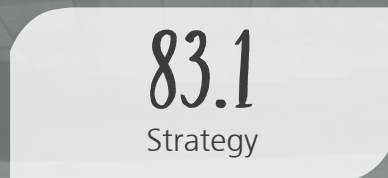
City Operations Centre



Bristol Is Open



The Bristol Approach to Citizen Sensing



4.1.1.2 Strategy

Bristol is the largest urban area in South West England, with a population of approximately 454,000 inhabitants. Bristol is part of the West of England Local Enterprise Partnership and of the new West of England Combined Authority. The area has one of the largest concentrations of microprocessor and network architects and strong local creative and digital media sectors. Despite its advantages, the city faces several challenges, including social inequality, congestion problems, housing issues and the need to improve employability and skills among its young people.

The Council's City Innovation Team works to pilot emerging smart city technologies. This team works with colleagues across all the authority's functional areas, and with external partners, to demonstrate the potential of these new ways of working. The team also works closely with Bristol Is Open and the City Operations Centre to see the most valuable solutions tested and deployed at scale.

A key element of Bristol's smart city and innovation strategy is a focus on citizen-centric solutions. The city council along with the Knowle West Media Centre and Ideas for Change, launched a programme called The Bristol Approach, which aims to put communities at the heart of innovation. The Bristol Approach focuses on supporting people to work together to identify the knowledge, technology, and resources needed to tackle a problem.

The city is also focusing on the development of smart districts, where a more holistic view can be taken across issues like transport, energy, housing, and the potential use of new technologies and better data. The EU-funded programme REPLICATE is delivering just such an integrated smart district in the east of the city.

4.1.1.3 Key Initiatives and Projects

Bristol Is Open is a JV between the city and the University of Bristol to provide a unique city scale communications and data sharing platform. At the core of the project is an open high speed network that provides a platform for multiple city applications. The project integrates three networks through software controls: fibre in the ground, a wireless het-net along the Brunel Mile area of Bristol with Wi-Fi, 3G, 4G, LTE, and 5G experiments, and a radio frequency mesh network deployed on 2,000 of the city's lampposts. The plan is for the network to be extended into the wider city region over the next couple of years, creating an open programmable region reaching across Bath, South Gloucestershire, and North Somerset, an area covering more than 1 million people.

Another significant development is the implementation of the City Operations Centre to provide integrated monitoring and management of city services, including the following:

- Traffic management and control
- Closed-circuit TV (CCTV) monitoring for safety and security
- Telecare services
- Alarm monitoring
- Out of hours call handling

Additional operations will be added gradually to the centre, and talks with various agencies and service providers are in progress. The aim is to have a single place to control the way the city works. Data from the City Operation Centre will feed into the city's open data platform. The data platform will open up the opportunity for businesses and citizens to develop and share information about the city, and to create new products or services.

There is close alignment between the work of the City Innovation Team, the City Operations Centre, and Bristol Is Open. The aim is to ensure innovation projects are focused on priorities facing the city and that there is pathway from pilot to broader implementation.

Another example of the city's focus on opportunities offered by big data is the Bristol Data Dome. The Data Dome is the result of a major upgrade to the city's planetarium to create a stereo 3D hemispherical screen with 4K resolution. It is connected to a high performance computer at the University of Bristol via the Bristol Is Open network. The Data Dome will be used for a range of public and private sector projects, including the use of data visualisation to support complex city planning and investment processes.

The city has been actively involving the community in its smart city strategy. An interesting citizen-driven project is the Damp Busters pilot. It used The Bristol Approach to developed new ways of measuring the problem of damp in homes, including designing a frog-shaped temperature and humidity sensor. The Damp Busters pilot is part of a larger Citizen Sensing strategy. Citizen Sensing is a process where people build, use, or act as sensors – for example, identifying and gathering information (or data) that will help them to tackle an issue that is important to them. This sensing process could involve creating a bespoke temperature sensor from scratch or using a piece of technology that already has an in-built sensor, like a smartphone.

Several initiatives are addressing the transport situation in the city, which has one of the highest levels of car use in the country. Real-time data access on traffic conditions and transport services is being provided to help people make smarter travel decisions. A series of highly successful hack events have been hosted, and resulted in a range of new transport apps being developed. The city is also supporting the deployment of EV charging stations and is actively trialling the use of AVs.

4.1.2 LONDON

4.1.2.1 Summary

London's smart city initiatives have been reinvigorated following the 2016 mayoral election. The appointment of a CDO for London reaffirms the city's leadership in the use of data to improve urban services. There has also been considerable progress in several London boroughs, notably in the ambitious Digital Greenwich programme, and in Westminster and Camden, for example. An ambitious new environmental plan, currently under consultation, should spur new citywide initiatives on priority issues such as air quality improvements.

Key areas of focus:



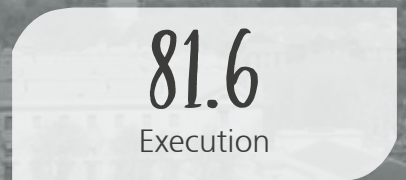
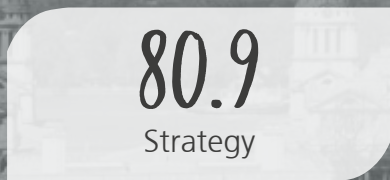
New Chief Data Officer and city-wide data initiatives



Sharing Cities demonstrator



London Environment Strategy



4.1.2.2 Strategy

London's size, wealth, global position, and continued expansion present unique advantage but also a series of distinct challenges. London is expected to be home to more than 11 million people by 2050. It benefits from its role as a centre for global finance, the base for leading technology companies, and home of world-renowned universities. However, it also faces a range of problems in terms of environmental pressures, infrastructure requirements, economic and social inequality, and a complex governance structure.

Responsibility for London's evolution towards a smart city is shared between the Mayor of London, the Greater London Authority, and the 33 London boroughs. The appointment of a new CDO for London is expected to drive greater collaboration across the London boroughs on a range of smart city and digital innovation programs. A London Office of Data Analytics (LODA) pilot has been underway since 2016 and there is also an exercise underway to scope a London Office of Technology and Innovation (LOTI). The aim of LOTI is to focus on the potential of data and digital technology to deliver real outcomes for London's frontline public services.

The Smart London Board, established in 2013, has also been refreshed in 2017. The board plays an advisory role to the mayor and the new CDO, with members from across the public sector, academia, leading technology suppliers, and small businesses.

4.1.2.3 Key Initiatives and Projects

London was an early proponent of the benefits of open data for urban innovation. The city took a strong lead with the establishment of the London Datastore and an extensive programme to encourage developers to use this data, with Transport for London being particularly notable for its collaboration with third parties. The focus in London is now on the quality and use of data to improve services and to achieve priority outcomes. For example, Westminster Council is leading a pilot project for LODA that uses combined data from across London boroughs to address the issue of problem landlords by enabling more efficient and effective inspection programmes. Several data mapping projects have also added new insights on London's assets, infrastructure, and services, including a London Heat Map, which supports energy efficiency and renewable energy initiatives. The London Development Database provides map-based access to data about the major planning permissions across London. The London Infrastructure Mapping Application is an online tool aimed at increasing coordination around infrastructure delivery and facilitating strategic planning across the capital. The current database contains over 12,000 infrastructure and construction projects that are underway, planned, or proposed.

London has a well-established commitment to reducing its carbon emissions. Its Low Carbon Capital strategy set a target to reduce carbon emissions by 60% by 2025 against 1990 levels, and to deliver 25% of its electricity from local renewable sources. A draft of the new London Environment Strategy was released for consultation in August 2017. This reaffirms existing targets but also advocates for the first time a joined-up approach across all relevant sectors – including energy, water, waste, transport, and buildings. One of the highest profile areas is air quality – which is a major focus for the new administration. An online consultation on air quality in the city has already gathered over 15,000 responses. The Mayor is also developing an energy supply company, Energy for Londoners, to develop clean and smart, integrated energy systems using local and renewable energy resources. The aim is to make London a zero-carbon city by 2050.

The Queen Elizabeth Olympic Park is developing a new smart district data infrastructure standard for a zero-carbon community, supported by technologies such as 3D mapping and virtual reality. There have been several IoT and sensor projects delivered on the Park which have focused on the collection of both quantitative and qualitative data, alongside studies relating to citizen engagement. The latest experiment is to have an autonomous (driverless) shuttle bus trial running on the Park.

Inevitably, there is great diversity in approaches to smart city development across the London boroughs, with each borough focusing on its own priorities and possibilities. Notable programmes include Camden's Digital Camden strategy and a series of data and technology projects in Westminster, including the deployment of smart parking technologies. One of the most ambitious programmes has been launched by the Royal Borough of Greenwich, led by the Digital Greenwich team. The borough is home to several advanced transport innovation projects.

Greenwich is also the London demonstration area for Sharing Cities, a €25 million EU Horizon 2020 project led by London, Milan, and Lisbon. The 3-year project, launched in January 2016, is developing, deploying, and integrating replicable solutions across the energy, transport, data, and information and communications technologies (ICT) sectors. The London projects include energy efficiency, renewable energy, urban mobility, and smart parking projects. One of the most ambitious projects is the development of a sustainable energy management system (SEMS) that is consolidating and analysing energy data from smart meters and other intelligent devices, to optimise energy production and consumption at a community-level. The SEMS also links to the broader urban data platform being developed as part of the Sharing Cities programme.

4.1.2.4 Digital Greenwich

The Royal Borough of Greenwich established Digital Greenwich as an in-house multidisciplinary team to help develop, implement, and manage its smart city strategy and initiatives. The Borough recognises that digital technology will be needed to help deliver modern infrastructure and city services, particularly in consideration of its strong population growth – Greenwich’s population is expected to rise by 34% between 2010 and 2028. Four primary areas are targeted for transformation as part of Greenwich’s smart city strategy: neighbourhoods and communities; infrastructure; public services; and the Greenwich economy.

As well as being the London site for the Sharing Cities project, Digital Greenwich is also host to several other demonstration projects, including:

- Move_UK, which is a consortium of automotive companies (led by Bosch) developing automated driving systems in the UK. The three-year project received a £5.5 million grant from Innovate UK to trial AV technology in real-world conditions in Greenwich, and aims to accelerate deployment of AVs in the UK.
- GATEway, also funded by Innovate UK, is led by TRL (the UK’s Transport Research Laboratory) and is focused on understanding public and industry perceptions and acceptance of AVs through demonstrations and user engagement. The £8 million initiative is technology agnostic, and aims to demonstrate safe and efficient integration of automated transport systems.

Additionally, the UK Smart Mobility Living Lab is also located in Greenwich, largely used for developing connected and automated vehicles in a real-life environment. Digital Greenwich also runs an innovation centre in the borough which connects businesses with local smart city programmes, other companies, and nearby universities. The centre is a showcase for clean technology – utilizing renewable energy, rainwater harvesting, and ground source cooling systems to achieve a carbon footprint of 35% below building regulations.

4.2.1

MANCHESTER

4.2.1.1 Summary

Manchester's smart city programme continues to gain momentum through extensive demonstrator projects and the impetus provided by its role at the heart of the new combined authority. CityVerve is a showcase project, but Manchester is also building on its established digital strategy, ambitions for regional devolution, and an extensive network of corporate partners.

Key areas of focus:



CityVerve smart city demonstrator



Zero carbon city by 2050



Corridor Manchester innovation district

74.3

Overall Score

73.7

Strategy

74.9

Execution

4.2.1.2 Strategy

Manchester is a central player in the emergence of the Northern Powerhouse, which aims to devolve more power to cities and close the economic divide between the North and South of Britain. As part of the new deal between the central government and the city region, the election of the first directly elected mayor for Greater Manchester in 2017 brings more devolution and fiscal power to the region. The city's vision is that, "by 2025 Manchester will be among the top 20 smart cities in the world."

Manchester's smart city strategy is coordinated through the Manchester Smart City programme, which has the six themes aimed at delivering better outcomes for the city and its citizens: Live, Work, Play, Move, Learn, and Organise. Each smart city project has a bias towards one or two of these areas but also connected with each of the others in some way.

In 2015, a consortium led by the city council was awarded £10 million to implement the CityVerve IoT Demonstrator project. The aim of the project is to demonstrate the capabilities of IoT applications at scale across a city region. The demonstrator project is giving Manchester the chance to further enhance its international position as a pioneer in the use of new urban technologies, as well as new forms of local governance. Underpinning Manchester's winning bid was its established digital strategy, ambitions for regional devolution, and network of corporate partners including Siemens, Cisco, and BT.

After the Paris Agreement on climate change, Manchester announced a commitment become a zero-carbon city by 2050, this has been formalised in the city's climate change strategy. The Manchester Climate Change Strategy 2017-2050 and the Implementation Plan for 2017-2022 were launched in December 2016.

4.2.1.3 Key Initiatives and Projects

The CityVerve demonstrator project aims to deploy the latest IoT technologies at city scale to deliver transformative benefits: new business and jobs, better healthcare, transport and education, and more engaged and empowered citizens. The project is making smart improvements to city infrastructure and services and includes community wellness initiatives, air quality monitoring, a cycling safety scheme, and talkative bus system. The £16 million project is backed by Innovate UK, which contributed £10 million through an IoT Demonstrator Award, and the rest is provided by private partners. Over 21 organisations from the public, corporate, and academic sectors are supporting the project.

Triangulum is a 5-year, €25 million European Commission Horizon 2020 project involving Manchester; Eindhoven, the Netherlands; and Stavanger, Norway. The aim of the project is to examine the impact of smart solutions on low carbon development, including reduced energy consumption in buildings, increased use of renewable energy, increased utilisation of EVs, deployment of intelligent energy management technologies, and the deployment of an adaptive and dynamic ICT data hub.

Manchester is also involved with the European Commission EU-China Smart Cities Forum project. An agreement is in place between several organisations involved in the UK-China smart cities initiative to develop a Joint Smart Cities Laboratory, colocated in Manchester and Shanghai. The three universities of Manchester, Manchester Metropolitan, and Salford, along with eForum, are establishing a smart cities laboratory in Manchester. Digital China is funding the Jiao Tang University to setup a similar initiative to foster deeper collaboration around current and future best practice in smart city design and technologies. The involved parties will undertake R&D activities to promote technological innovation that affect the urban environment.

Many of Manchester's smart city projects, including Triangulum and the IoT Demonstrator, are concentrated in Corridor Manchester, a 243-hectare area stretching from St. Peter's Square to Whitworth Park that is fast becoming an R&D hub and includes cultural venues, a science park and development projects.

4.2.2

BIRMINGHAM

4.2.2.1 Summary

Birmingham's smart city programme is moving into a new phase as it seeks to more closely integrate its digital innovation programmes and city's operational activities. Working closely with other agencies across the West Midland combined authority is also becoming an important shaper for smart city infrastructure investment and other digital enablers. New projects to extend the role of data in city policy making, like the Big Data Corridor and Driven Interactive Smart City (DISC), are indicators of the next stage in making digital innovation a core element in the city's strategy.

Key areas of focus:



East Birmingham
smart city demonstrator



Big Data Corridor



City4Age

74.2

Overall Score

77.6

Strategy

70.7

Execution

4.2.2.2 Strategy

The Metropolitan Borough of Birmingham is home to more than 1.1 million people and is the second largest city in the UK. Birmingham sits at the heart of the West Midlands region and combined authority, which is made up of seven metropolitan boroughs including the cities of Birmingham, Coventry, and Wolverhampton. As a growing city that is expected to increase in population by 10% by 2026, Birmingham faces challenges in providing infrastructure and housing, and in developing local skills to meet the requirements of the city's new and evolving businesses.

Birmingham's smart city strategy has its roots in the work of Birmingham Smart City Commission, created by the Birmingham City Council in 2012 and involving representatives from business, academia, and the public sector. The Commission was responsible for developing the city's initial smart city roadmap, which was then refined through a process of consultation with other stakeholders. The city is now in the process of revising and updating its smart city strategy, shaped in part by its new ICT and Digital Strategy and even closer collaboration with other stakeholders in the West Midlands Combined Authority.

Digital Birmingham is the council organisation responsible for coordinating overall progress against the city's smart city roadmap, working with the various city delivery agencies and partners. There is a strong digital component in the smart city strategy and a strong emphasis on embedding digital perspectives on city operations, new infrastructure investments, and citizen services.

Birmingham is also looking to develop an Innovation Advisory Group, including representatives from local universities, major suppliers, SMEs, and other agencies. The aim of the group is to help the council identify more disruptive innovations that can help improve services. This is part of a wider strategy to accelerate the adoption of new ideas and solutions within the city.

4.2.2.3 Key Initiatives and Projects

Current and planned projects in Birmingham span most aspects of city operations. Birmingham has several different programmes and initiatives revolving around data. The Birmingham Data Factory is a platform for accessing the city's open datasets. Data is currently available from the city council (which has an open-by-default policy), Centro (the West Midlands transport providers), and other agencies. The plan is for the Data Factory to become an information marketplace for use by diverse data providers. The West Midlands Open Data Forum brings together data experts, enthusiasts, and developers from across a variety of sectors that are actively using the data available.

In 2017, Digital Birmingham launched two new data initiatives: Big Data Corridor and Data-DISC decision support toolkit. Big Data Corridor is a grant funded programme in conjunction with the European Development Fund, Aston University, Birmingham City University, and other partners to help SMEs benefit from access to technical and commercial support for exploiting data. DISC is a collaborative project involving Birmingham City University, Digital Birmingham, Future Cities Catapult, and private sector partners, and aims to simplify complex decision-making, informing policy and strategic service developments using unified data, simulation, and modelling.

Birmingham is also one of the cities involved in the EU Horizon2020 project, City4Age. The programme is looking at the use of digital technology to improve the support for the frail and elderly population within urban communities.

Smart Routing is a new smart transport initiative. Smart Routing is a trial software platform built into Birmingham's existing Commuter App that uses real-time transportation data and personal data to support more efficient transportation planning, even when users are offline.

One of the most ambitious programmes in the city is the East Birmingham Smart City Demonstrator, where various smart city concepts and technologies are being developed relating to mobility, health, skills, enterprise development, and information marketplaces. This builds on the initial smart city roadmap and will have a strong focus on outcomes that have an impact on the local community rather than technology pilots.

The city council's Green Commission established the city's carbon target as a 60% reduction in total emissions by 2027 and 80% by 2050 from 1990 levels. A number of energy and sustainability projects have already been implemented. The existing Birmingham District Energy Scheme is being extended through the city centre, and there are plans to establish a city energy services company.

Throughout the city's various programs and initiatives, Birmingham has involved local universities and SMEs. The city also plays host to incubator projects, including the Energy Research Accelerator, which is supported by several universities in the West Midlands, the national Energy Systems Catapult, and Serendip Smart City Incubator, which supports startups in digital health, mobility, IoT, and smart cities.

The city has been investing in its digital and data infrastructure. Public Wi-Fi is available across the city centre following a project between the Birmingham City Council and Virgin Media Business; Wi-Fi has also been installed in over 200 public buildings. A consultation is now taking place as to future connectivity needs of the region, including low power networks and future possibilities for 5G networks, with the aim of ensuring seamless communication support for services across the region.

4.2.3

LEEDS

4.2.3.1 Summary

Leeds is laying down strong foundations to enable data and technology to support its goals as a city. This is most evident in its focus on integrated approaches to developing health and care services. It has built strong collaborative networks to achieve this, as it has also done in the development of Data Mill North and its broader data strategy. It is now looking at the requirements for robust city communications that can underpin future development across a range of IoT and other technology innovations. Common leadership for digital transformation and smart city innovations also enables Leeds to ensure closer alignment between innovation programs and the priorities for city services.

Key areas of focus:



Age Friendly Smart City



Integrated health care



Data Mill North

74.0

Overall Score

75.2

Strategy

72.8

Execution

4.2.3.2 Strategy

Leeds is at the heart of one of the UK's largest metropolitan regions. It is the second largest unitary council in the country, covering a population of around 775,000. It sits at the heart of the Leeds City Region, encompassing 3 million people across West Yorkshire.

Leeds City Council's ambitions are defined by its goal to be the best city and best council in the UK by 2030. Its strategy embraces all aspects of city operations as well as ambitious environmental goals. Digital technologies and better data are key elements in achieving these goals. Leeds is building on its close relationships with the NHS, the capabilities of the University of Leeds, and a diverse range of partners that have made Data Mill North one of the most advanced open data platforms in the country.

One of the most notable priorities is Leeds' commitment to improving services for older residents. The city recently refreshed its Health and Wellbeing Strategy (2016-2021) to include an Age Friendly Smart City project with the objective of developing robust technology solutions that can empower older residents and make Leeds the best city to grow old in. To achieve these and other goals, there is a growing emphasis on the need for a citywide perspective that takes in all aspects of the city, not just council-delivered services.

The city's smart city initiatives are steered by a Smart City Board that reports to the city council. The Board includes representatives from city departments and relevant teams, and is chaired by the city CIO. A set of digital principles have been agreed upon to help ensure that the opportunities offered by digital technologies are given due consideration in the early stages of planning and the design of new projects.

4.2.3.3 Key Initiatives and Projects

The development of open data and data analytics continues to underpin the Leeds smart city initiative. The Leeds Data Mill, now Data Mill North, was one of the first platforms in the UK to bring together open data information from multiple sectors and to enable that data to be accessed for analysis and to develop new service solutions. Data Mill North is part of several data-focused initiatives in the city, including the Leeds Institute for Data Analytics at the University of Leeds and the work of NHS Digital, which is based in the city.

One example of the city's approach to integrated healthcare is the Leeds Care Record. This is an integrated system to provide health and social care practitioners in the city with an integrated view of patient information. General practitioners, for example, have direct access to patient hospital reports as part of a single application.

Leeds is a partner in the EU's ActiveAge, Horizon 2020 project. Leeds is focusing on two core use cases as part of its involvement: independent living support and personal health and symptoms monitoring. The Leeds consortium is deploying energy monitoring equipment along with home sensors and smart multifunctional wearables (smart watches) to provide services around fall detection, emergency triggers, remote monitoring of vital health stats, and other detection system to help give confidence for elders to sustain their lives in their homes for a longer time. The Leeds team has already recruited around 1,000 residents for the project. Other digital inclusion initiatives include a tablet-lending scheme managed through the city's library service and an initial deployment of broadband and Wi-Fi in social housing schemes.

The Assisted Living Leeds Innovation Lab (ALL IN) is an example of a project to drive innovation within the field of assistive technology. It enables innovators and product developers to connect with end users of assistive technology, and with health and social care professionals.

The city has also been investing in its communications infrastructure, with free Wi-Fi now available in over 200 public buildings. The city is now looking to extend Wi-Fi further across the city as part of a broader strategy to prepare for the wider deployment of IoT solutions and the coming of 5G networks, including an assessment of future fibre network requirements. A LoRa low powered network is being deployed and a SIGFOX network is also available.

4.2.4

MILTON KEYNES

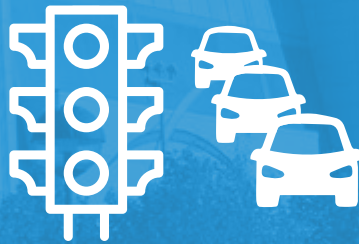
4.2.4.1 Summary

Milton Keynes' commitment to being a prime location to the development and testing of new city technologies and services is entering a new phase. MK:Smart is rolling on under new funding arrangements, which will see more active engagement from a broader range of commercial partners. The breadth of Milton Keynes work on transport innovation is particularly notable, spanning EV support, AV trials, real-time mobility data, and citizen mobility apps. The challenge is to move to larger-scale deployments – beginning with the Vivacity parking and traffic management system – and to accelerate local adoption of successful solutions.

Key areas of focus:



MK Data Hub



Intelligent traffic management



Autonomous vehicle pioneer

73.5

Overall Score

75.8

Strategy

71.1

Execution

4.2.4.2 Strategy

The MK:Smart programme serves as the foundation of Milton Keynes' development as a smart city. The programme was set up to develop innovative solutions to support economic growth, reduce carbon emissions, and improve services in the city. MK:Smart is a collaborative initiative that was partly funded by the Higher Education Funding Council for England and led by The Open University, the Milton Keynes Council, and BT, with support from a number of technology partners. In June 2017, the funding phase for MK:Smart officially finished. However, the brand and the programme will continue. The council has committed an additional investment of £500,000 to continue the programme for another 2 years, principally to support the development and maintenance of the core infrastructure and the Data Hub portal. The programme is also extending its relationship with other partners including BT, Huawei, and Tech Mahindra. The Open University will continue to play a key role in directing the programme.

The MK Futures 2050 Commission was established to develop a view of the long-term future for the city and make recommendations for council policy to match this vision. The Commission published its report and final recommendations for Six Big Projects in July 2016, all of which were supported by Milton Keynes Council. The development of the MK:Smart programme is being aligned with the major projects highlighted in MK Futures 2050, which span economic growth, the establishment of a new technical university, an emphasis on education improvement: smart, shared, and sustainable mobility; the renaissance of the city centre; and development of a creative and cultured city.

4.2.4.3 Key Initiatives and Projects

Milton Keynes was one of the first urban regions to implement a network based on IoT technology. In 2013, a consortium of infrastructure providers, SMEs, and government-backed innovation centres established the UK's first citywide low power wireless access network. Recycling bins and parking spaces were among the first things to be connected to the Internet, and the deployment of sensors has been extended to include initiatives such as people presence and soil moisture in parks. Sensors are also being used to monitor transport, energy, waste collection, and water systems as part of the demonstration projects.

The MK Data Hub provides the data infrastructure for the MK:Smart project, supporting the collection, integration, and use of data across multiple applications. This includes data about energy and water consumption, transport, pollution, social and economic datasets, and crowdsourced data from social media or specialised apps. The Data Hub currently has over 700 datasets that are being used to support intelligent planning and utilisation of resources across Milton Keynes' city services. The hub includes advanced arrangements for the governance and management of data and easy access for developers through smart APIs.

Transport and urban mobility is one of the key focus areas for innovation in the city. MK:Smart is promoting the concept of Cloud-Enabled Mobility. This project connects users with real-time data to enable informed local travel decisions (e.g., booking and billing systems), which can reduce time wasted and traffic congestion. The information

is made available to the public via a new citywide app known as MotionMap (a user trial started in April 2017). The next phase of the project will involve analysing the findings from the user trial, as well as using MotionMap to enable new forms of public transport such as AVs and mobility on-demand.

In October 2016, the first AV demonstration in Europe took place in Milton Keynes as part of a 3-year demonstration project – UK Autodrive. Among the partners in the consortium are Jaguar Land Rover, Ford, Tata, the University of Oxford, and the University of Cambridge. New protocols are expected to be developed for AVs, as well as the continued testing of the public reactions to both driverless cars and fully automated, self-driving pods for pedestrianised spaces. The UK Autodrive project has announced a goal of having 40 of these pods operational as a limited public service by summer 2018.

The first AI-enabled traffic management system in the world will be deployed in Milton Keynes by autumn 2018. Supported by an Innovate UK first-of-a-kind grant, Vivacity Labs will install 2,500 video sensors to monitor major intersections and 13,000 surface car parking spaces to reduce traffic congestion. When fully deployed, the system will be able to dynamically prioritise emergency vehicles, buses, and cyclists when appropriate.

MK:Smart is also looking at ways to improve energy efficiency in the city. Several initiatives are underway or recently completed, including the FALCON smart grid project, a comprehensive EV charging infrastructure network, wireless induction charging for bus services, and a district heating system. Additionally, as part of the Community Action Platform for Energy project, an Open Energy Map is being built to better understand local energy trends and generate community energy projects.

In addition to the array of technical solutions being developed, MK: Smart also offers an integrated programme of business, education, and community engagement. An Innovation and Incubation Centre at University Campus Milton Keynes is designed to integrate training and support for data-driven business innovation and the digital economy, with hands-on support for business development at the point of need, virtual and physical demonstration facilities, and an incubation space.

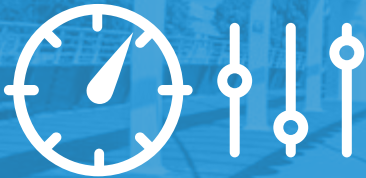
4.2.5

GLASGOW

4.2.5.1 Summary

As recipient of the Future Cities Demonstrator award, Glasgow has been given an enviable foundation for its development as a smart city. The city now has the infrastructure in place to support larger projects, and the capability to be more proactive in managing public services. The challenge now is to ensure that momentum is maintained on the most successful projects and that the spirit of innovation is retained. Glasgow's role as lead partner in the Scottish Smart Cities Alliance is providing the city with more opportunities to build on its experience.

Key areas of focus:



Glasgow Operations Centre



City Energy Model



Smart street lighting

71.9

Overall Score

70.9

Strategy

73.0

Execution

4.2.5.2 Strategy

Glasgow's smart city ambitions received a significant boost when it was awarded the £24 million Future City Demonstrator grant in 2013. The award has been used to fund a series of projects across the city that aim to improve the lives of Glasgow citizens and to establish the city as a centre of urban innovation. Whilst the Demonstrator projects were completed at the end of 2015, Glasgow's smart city development has expanded through the Scottish Cities Alliance, for which Glasgow is leading the Smart Cities Scotland workstream.

4.2.5.3 Key Initiatives and Projects

The Future City Demonstrator has been the main programme for smart city innovation in Glasgow, with projects covering data, energy, building innovations, and lighting.

A key development has been the new Glasgow Operations Centre, which accounted for nearly half of the total programme funding from the Future Cities Demonstrator. The centre has a state-of-the-art integrated traffic and public safety management system, enabling the city to take proactive approaches and have real-time responses to managing city services such as public space CCTV, municipal building security, traffic management, and police intelligence.

Open Glasgow is the platform developed to share public sector datasets from the city council and other organisations and to provide a gateway to the city dashboard, an online, personalised dashboard that presents real-time data to citizens. In addition, the Data Launchpad provides a platform for multiple organisations to share data that can help provide insight into the city.

Glasgow's smart city initiatives also promote digital inclusion. The city worked with the Wheatley Group to complete two pilot projects, which provided low cost broadband to its social housing tenants. The first pilot included 12 homes experimenting with three technical options for Internet access; hardwire broadband, Wi-Fi, and Ethernet over power lines. This was followed by a second, larger pilot checking Wi-Fi connectivity in a multi-storey block with 138 units. Results from the pilots show large increases in Internet and email usage, as well as higher confidence using the Internet by the tenants. The city is also running a Digital Apprentices programme to increase the digital skills of young people starting their careers. Finally, the city has set up 36 Click and Connect computer learning centres to help more residents get online.

The city has several significant energy and sustainability projects underway. The Glasgow City Energy Model maps the energy consumption of residents and businesses across Glasgow in 2D and 3D, these can be viewed by residents on the web portal or through the Energy App developed as part of the demonstrator. The app can recommend retrofit options to users that will make their home more energy efficient. The city has several building energy management projects, including pilots that use sensor technologies to measure ambient temperature and humidity levels, and the use of demand-side management for city council properties (in collaboration with Siemens and ScottishPower Energy Networks).

Smart street lighting is one of the other successful pilots initiated under the Future City Demonstrator. Three smart street lighting pilots have been deployed at Riverside Walkway, Gordon Street, and Merchant City. The smart street lights are improving energy efficiency and are also being used to support other applications such as monitoring movement (footfall and traffic flow), air, and noise pollution levels. The plan is to now extend the street lighting to the rest of the city, working in conjunction with other cities as part of Smart Cities Scotland.

Glasgow has also laid out a detailed transport plan in its Glasgow City Centre Transport Strategy (2014-2024) report. In addition to public transport infrastructure improvements such as subway modernisation, the strategy prioritises walking and cycling. The report also highlights the role of improved traffic management and parking strategies, smart and integrated ticketing, and low emissions zones.

Glasgow is the lead partner for the Smart Cities Scotland workstream for the Scottish Cities Alliance. Under the programme, Glasgow is involved in projects in the areas of smart street lighting, data, smart waste, water management, and smart communities.

4.2.6

NOTTINGHAM

4.2.6.1 Summary

Nottingham has built up a strong roster of smart projects and initiatives, particularly for energy and transport services. It is now starting to bring these together within a broader, more coordinated smart city strategy. The fact that Nottingham still has ownership and control of a significant portfolio of city assets and service has helped shape its success with its city-owned energy company, public transport innovations, and social housing programmes. It is well-placed now to build on these initiatives to look at interconnected issues around transport, energy, housing, and health.

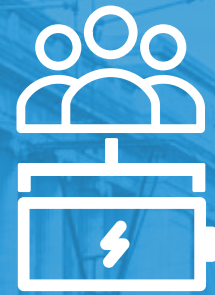
Key areas of focus:



Smart energy city



Low carbon transport



New models for community energy

69.5

Overall Score

67.7

Strategy

71.3

Execution

4.2.6.2 Strategy

Nottingham has a population of around 314,000 and is at the heart of a region of nearly 756,000. City leadership has set a strong emphasis on energy and transport policy, and is also focused on making Nottingham one of Europe's leading cities for science and innovation.

The city is now developing a coordinated smart city framework that will bring broader cohesion to the wide range of current and projects city innovation programmes around the theme of creating a smart and liveable city. The four focus areas are clean, sustainable, and low cost energy, mobility (including addressing air quality and congestion challenges), improvement in district health (in particular inequalities in life expectancy), and housing improvements. The city's two universities – the University of Nottingham and Trent University – are partners and co-leaders in the development of the smart city strategy.

Energy sustainability has been a priority for Nottingham City Council since it published a 10-year action plan strategy in April 2010. This action plan included generating more local energy via solar PV and biomass combined heat and power (CHP) systems, as well as through cutting demand. Nottingham now claims it is both the most energy self-sufficient and least car-dependent city in the country. The Nottingham City Council has direct control over much of the city's infrastructure, transport, and housing stock, which it believes is an important factor in being able to deliver a smart city in practice.

4.2.6.3 Key Initiatives and Projects

Nottingham has strong ambitions to be a smart energy city. As laid out in its Energy Strategy 2010-2020 report, the city aims to deliver 20% of its energy from renewable sources by 2020. The plan also set a target to reduce carbon emissions by 26% by 2020 compared to 2025. The city has already reached its emissions target 4 years ahead of plan.

The city-owned energy company, Robin Hood Energy, was established to deliver low cost energy to city households and businesses and is now also looking at furthering the city's use of clean energy. Robin Hood Energy also provides white-labelled energy company services to other cities, including the Leeds region and Liverpool.

Located in the new Trent Basin development, Project SCENE is a sustainable community energy project supported by Innovate UK funding and the Energy Research Accelerator. The project brings together companies involved in the energy supply chain and academics to work with around 120 homes to deliver new models for community energy schemes. The project is also deploying a 2 MW Tesla battery in what is expected to be Europe's largest community battery installation.

Nottingham Energy Partnership (NEP) has also delivered a solar battery storage project, Sungain Battery Bank, which allows 35 private households with rooftop solar to utilise 30% more of their generated energy. An extensive district heating system, the 100% council-owned Enviroenergy provides heating to 4,500 domestic and 150 commercial clients via high pressure steam from a waste incineration plan.

The city council's Energy Projects Service is delivering a multi-million-pound programme of projects across Nottingham including commercial battery storage, rooftop, canopy and ground mounted solar PV, innovative fuel cells, boiler replacements, and LED lighting. A low energy street lighting replacement plan with integrated 4G controls is currently being rolled-out. This project includes the replacement of approximately 35,000 street lights (most of which has been completed) and the maintenance of approximately 42,000 units over a 25-year period.

Transport innovation is another focus for the city and has been closely linked to Nottingham's energy and carbon reduction strategy. A smart ticketing system, Robin Hood Network, is in operation for the public transport network. The network also has an integrated system that displays real-time information for bus and tram arrivals and alternative cycling routes on over 1,500 screens across the region and through the Robin Hood travel app. Over 8 million public transport journeys are now made via the Robin Hood platform each year.

Nottingham received £5 million of funding from the EU's Horizon 2020 research and innovation programme as a lighthouse city for the Remourban project to tackle sustainability issues concerning transport, energy, and ICT. Launched in 2015, the Remourban project is a collaboration between Nottingham City Council, Nottingham Trent University, Nottingham City Homes, and NEP in addition to two SMEs, INFOHUB and SASIE.

Transport options also include an hourly EV rental scheme (City Car Club Nottingham, run by Enterprise) and a fleet of 38 electric buses, including 13 new BYD electric buses with smart charging. A new option under development is a last-mile delivery hub managed by WEGO, in which eight EVs will deliver on behalf of hauliers to minimise the number of trucks entering the city.

The University of Nottingham has initiated a smart campus project that is also acting as a testbed for city innovation. For example, it has been analysing mobility patterns between campus sites and the insights are now being applied to the city bike scheme. The campus is also home to eight Living Lab homes that are trialling new ways to build affordable and environmentally friendly homes.

The city has also been working on the development of its open data strategy. There are two platforms, the city council's own open data site and Nottingham Insight – the former provides datasets from the council whilst the latter includes a wide range of data, information and analysis from the public sector across Nottinghamshire.

4.2.7

PETERBOROUGH

4.2.7.1 Summary

With the establishment of Future Peterborough, the city has transitioned from its Peterborough DNA initiative to a full-fledged smart cities programme focused on integrating and scaling up successful initiatives. The city's focus on a range of environmental programmes, particularly its development as a Circular City, provides an important and unique perspective on city innovation, notably demonstrated by the Share Peterborough platform.

Key areas of focus:



Circular city



Share Peterborough



Sustainable Drainage IoT project

65.1

Overall Score

67.4

Strategy

62.8

Execution

4.2.7.2 Strategy

Peterborough is one of the fastest growing cities in the UK, with a current population of about 190,000 and a wider catchment area of more than 950,000. Smart city solutions are viewed as a key element in an integrated approach to addressing Peterborough's challenges, and the city's aim to establish itself as the UK's Environment Capital. There is close collaboration between the smart city, economic, and environment programmes, including shared leadership. Notably, Peterborough is developing a distinct focus on the circular economy with its detailed vision of the future Circular City.

In 2012, Peterborough was awarded £3 million by Innovate UK under its Future Cities Demonstrator competition. The resulting programme, Peterborough DNA, has been jointly led by the city council and its economic development company, Opportunity Peterborough. In 2016, Peterborough began scaling up the projects delivered as part of Peterborough DNA through the establishment of the Future Peterborough program. This transition was fostered by Peterborough's Smart City Leadership Program, which works to drive forward and monitor smart city progress. Future Peterborough focuses on four key strands of activity: intelligence, people, smart leadership, and circular economy principles.

Digital technologies and innovation programmes are viewed as key elements in an integrated approach to addressing Peterborough's challenges, and the city's aim to establish itself as the UK's Environment Capital.

In April, 2017 the city council adopted a new Environment Action Plan for the city. As well as a plan for council-specific policies and targets for the city council, there is also a citywide plan developed with stakeholder organisations across the city. These plans, broken down into 10 areas and including interim targets to 2020 and goals for 2050, provide a vision for how the Environment Capital will be delivered.

4.2.7.3 Key Initiatives and Projects

One of the most successful projects to come out of the Peterborough DNA pilots is Share Peterborough, an online, resource-sharing platform for businesses and other organisations in the city. Members can use the platform to share any available resources including equipment, skills, spaces, and services. The platform now has over 100 members ranging from global corporations to local businesses and charities. Shared Peterborough started as a pilot in a small business district and has grown into a broader strategy for the Circular City that emphasises collaboration and sustainability through maximising resources.

The Digital Peterborough project is transitioning Peterborough into a Gigabit city by developing a citywide fibre Internet infrastructure. The project now connects 107 public sector sites with a 90 km (and growing) core fibre network, and over 200 businesses are taking Gigabit Internet services. The Peterborough City Council will soon be connecting 220 new sites to the network made up of CCTV cameras, Wi-Fi connections, and a network of traffic system locations.

An example of digital innovation in the city is the IoT-based Sustainable Drainage project. Peterborough's geographic location and changing climate patterns make it increasingly susceptible to surface flooding. The city has implemented river level and rainfall sensors across the city to enable better management of flood risk. The sensor network enables experts to intelligently understand and react appropriately when rising river levels may result in surface water flooding and to plan effective interventions much more quickly.

4.2.8

CAMBRIDGE

4.2.8.1 Summary

Smart Cambridge has used initial funding from the Cambridge City Deal to establish a range of smart city innovation projects and a platform for further development in the Greater Cambridge area and beyond. The combination of local authority and university initiatives provides a strong basis for future exploitation of the platform to improve city services. With further funding now available for projects to address transport, housing, energy, and health improvements, Cambridge is well positioned to develop larger and more extensive projects in future.

Key areas of focus:



Smart Cambridge
intelligent City Platform



Cambridge Insight
open data platform



Air quality
monitoring project

63.1

Overall Score

66.9

Strategy

59.2

Execution

4.2.8.1 Strategy

The Greater Cambridge Partnership is the local delivery body for the Cambridge City Deal, which is one of the largest city deal programmes in the UK. Greater Cambridge Partnership's goal is to bring powers and investment, worth up to £1 billion over 15 years, to vital improvements in infrastructure. Partners include Cambridgeshire County Council, Cambridge City Council, South Cambridgeshire District Council, University of Cambridge, and Greater Cambridge Greater Peterborough Local Enterprise Partnership.

Greater Cambridge Partnership provided an initial investment of £300,000 in the Smart Cambridge programme, which was established in August 2015, to develop smart city initiatives in the region. A programme board and advisory group set up under the Greater Cambridge Partnership provides governance and guidance for the work of Smart Cambridge.

A key focus for that initial phase was the establishment of a common management platform for IoT-based innovation projects.

Additional funding has now been made available from the city deal to enable Smart Cambridge to support projects using data and digital technologies to address challenges in four key areas:

- Transport: Making travel easier, reducing congestion, and exploring intelligent mobility
- Environment: Managing our water, energy, air quality, and waste
- Healthcare: Catering for an aging population and providing public health
- Smart living: Improving the quality of life for communities in and around the city

4.2.8.2 Key Initiatives and Projects

Working closely with the University of Cambridge, Smart Cambridge has established the Smart Cambridge intelligent City Platform (iCP) to provide a common platform for a variety of IoT-based projects. The partners have also established a citywide LoRa low power network for demonstration IoT projects. Open APIs will soon be added to the network to enable a wider range of organisations to access and use the network for projects. The network is managed by the University of Cambridge.

One of the most extensive of the initial projects on the network is an air quality monitoring system for the city. Twenty air quality sensors were added to the network to provide more granular information on city pollution levels. Work is now being done with the university to explore how this project might be extended to a wider range of sensors. Other initial projects include traffic monitoring sensors and the provision of real-time bus and train information.

Smart Cambridge publishes data through a countywide partnership, Cambridge Insight. Cambridge Insight provides an open data platform for sharing data and a research knowledge base for the Cambridgeshire area. The links with the University of Cambridge are particularly important for expanding the use of data for city improvement. The university is providing computing, networking, and analytic resources, and is leading the way in the investigation of the use of machine learning and predictive analytics on city data.

Improving transport in the region and reducing city congestion are important focus areas for Smart Cambridge. In early 2018, Cambridge intends to release its own mobile app that will provide information and support for users of local transport services. Other projects being considered include the development of a unified ticketing scheme, the potential role of AVs in Cambridge, and the feasibility of new rapid transit solutions (and how these might integrate with emerging technologies like AVs). Cambridge is building a super cycleway network, expanding bus services and Park & Ride sites. It is also aiming to improve the management and use of on-street and workplace parking through smart technologies.

The Connecting Cambridgeshire programme, in conjunction with commercial providers, aims to improve Cambridgeshire's digital infrastructure with better broadband, free public Wi-Fi, and wider mobile coverage. In January 2016, the programme completed the first phase of its superfast fibre broadband rollout, meaning more than 300,000 households and businesses now have access to fibre-based broadband. Combined with commercial provision, the fibre rollout has now reached 95% of homes and businesses across the county. Connecting Cambridgeshire has also assisted almost 2,000 business in becoming connected, and has provided free public Wi-Fi in more than 120 public buildings and open spaces.

4.2.9

OXFORD

4.2.9.1 Summary

Oxford has ambitious plans to improve city services and support the growth and creation of high value jobs under its banner smart cities program “Smart Oxford – a Learning City for the 22nd Century”. Oxford has played host to several smart city projects, driven by major technology companies, universities, and grass roots community groups. Smart Oxford is now building a more cohesive narrative around smart city development based on the strong collaborative network that has been established.

Key areas of focus:



Autonomous vehicle and low-carbon transport projects



The Oxford Flood Network



Oxfordshire Open Data

62.6

Overall Score

64.8

Strategy

60.4

Execution

4.2.9.2 Strategy

Oxford is one of the UK's fastest growing cities. It is home to over 5,000 businesses and 130,000 jobs, and is internationally renowned for its academic excellence. The city has a high concentration of multi-million-pound science and technology facilities, supporting world-class research in fields such as advanced engineering, manufacturing and life sciences.

The Smart Oxford initiative is supported by the Oxford Strategic Partnership (OSP), a group of collaborating organisations from across the public sector, academia, business and voluntary and community organisations. Day-to-day coordination and planning of the Smart Oxford programme is carried out by members of the Smart Oxford project board, and individuals drawn from local organisations. The programme is focusing on issues around transport, health, and the environment.

The governance structure for Smart Oxford has been purposely arranged to not be led by a single entity, which has helped build a culture of trust and collaboration among partners. This approach is also reflected in the focus on developing Oxford as a Shared City that is inclusive of all communities. Smart Oxford is building on the strengths of the city and that community to compete for national and European funding for innovation projects. Oxford was one of nine finalists for the 2016 European Capital of Innovation award.

4.2.9.3 Key Initiatives and Projects

Several significant transport innovation programs are being deployed in Oxford and the surrounding county, including:

- CASPAR, supported by the Department of Transport, is a project focused on providing real-time information regarding the availability of blue badge parking spaces. The project involves the installation of sensors and camera monitoring technology within Oxford and Witney that will provide real-time car parking and EV charge point availability data. The information will be integrated with Oxfordshire CC's Urban Traffic Management Control System.
- Oxfordshire CC is participating in the OneTRANSPORT project and has helped to create a OneM2M-based Open Ecosystem for Nationwide Transport Integration. The project aims to make transport more user friendly and accessible across local authorities and bringing all transport related data to one platform.
- In July a major connected and autonomous vehicles (CAV) project; DRIVEN was launched in Oxford, this is a collaboration led by Oxbotica and a range of partners to deliver the first UK fleet of multi provider CAV's.

- People in Autonomous Vehicles in Urban Environments (PAVE) is an Oxfordshire based consortium made up of RACE, Siemens, Amey, Oxbotica and Westbourne to understand what people think about driverless cars, using the Culham Science Centre in Oxford as a test location. This is the first study of its kind in the UK to assess public perception around driverless cars.
- Oxford's Go Ultra Low project is a joint city and county council project to test the best solutions for on-street charging in Oxford's terraced streets, with the initial aim of deploying 100 charge points across the city.

Smart Oxford is closely connected to MobOx a Community Interest Company, with links to Oxford University and Brookes University a range of entrepreneurs and Oxfordshire CC. It was established to support Oxford as a living lab for mobility and support R&D and business modelling in Oxford. A current focus is developing a mobility-as-a-service solution with a broad network of partners in Oxford.

The Oxford Flood Network is a citizen-based initiative to detect floods using an IoT network of sensors to monitor water levels in local rivers and streams. The project has been supported by Nominet UK, which has been working closely with Smart Oxford on the deployment of IoT pilots. Over the next year, the project aims to ramp up to 100 sensors to provide a detailed view of the waterways of Oxford.

An example of increasingly close collaboration between the city and its universities is a project between Oxford Robotics Institute and Oxford City Council to trialling city mapping technology. Sensors are being attached to a council street cleaner in the city centre to create 3D maps that can be used to trial the development of autonomous vehicles. The data can also be used to help the council better manage city operations, from road maintenance, to air quality, to waste management.

Oxfordshire Open Data is an open data platform jointly managed by the city and county councils. It provides a platform for the public, researchers and developers to access, analyse and share information about the Oxfordshire. The aim is to develop the platform as an open resource to support service innovation and to reduce the cost of information sharing across local agencies.

Better Broadband for Oxfordshire is targeting superfast broadband access to at least 71,000 homes and businesses, meaning at least 95 per cent of all premises in Oxford will have superfast broadband access by the end of 2017. Oxford provides free wireless provision in public buildings and a wireless concession in public spaces is expected to be procured in 2017.

4.2.10

ABERDEEN

4.2.10.1 Summary

Aberdeen has embarked on a major reappraisal of the city council's operational strategy with the aim of creating a new framework for improving city operations and providing a platform for future innovation with a clear focus on the city's priorities. Aberdeen's approach will be watched closely by other cities as it looks to take a lead in developing the policy innovations needed to turn smart city visions into reality. The city has already undertaken a range of innovative energy and transport projects and has begun a smart street lighting pilot. The city is also developing plans for the evolution of its communication infrastructure.

Key areas of focus:



Target Operating Model



PORTIS - urban mobility for port cities



Renewable energy and hydrogen transport programmes

62.5

Overall Score

68.8

Strategy

55.4

Execution

4.2.10.2 Strategy

Aberdeen is Scotland's third-largest city and a leading business hub in the UK. Whilst most economic activity in the city has historically been in primary industries such as oil & gas, Aberdeen is quickly moving to diversify its economy. As employment in the fossil fuel sector is declining, renewable energy development, clean transportation technologies, and digital infrastructure expansion are key areas primed for growth. As a major port city, with the harbour an integral part of the city environment, the operations of the port and its broader impact on the development of the city are important elements in the city's overall strategy.

Aberdeen City Council and community planning partners have agreed to a 10-year programme under the Local Outcome Improvement Plan 2016 to ensure Aberdeen is "A place where all people can prosper."

The 10-year plan aims to break the cycle of deprivation which exists for some communities in Aberdeen to create a cycle of prosperity through the delivery of four priorities for partnership working:

- A prosperous Aberdeen
- A recognition that children are our future
- That people are resilient, included, and supported when needed
- The empowerment of resilient and sustainable communities

A fifth priority of Creating a Digital Place cuts across all priority areas as a key enabler of innovative and integrated future public services.

In August 2017, the city council approved a new framework referred to as the Target Operating Model, which will provide the strategic vision and governance models for the transformation of council services over the coming year. The new model provides a cross-sector, design-focused perspective on the city's strategic priorities. The Target Operating Model will look at future smart city developments as a core part of the design response to these priority needs. It also paves the way for establishing new partnerships with the private sector partners, citizens and community interests to deliver the necessary platforms, and solutions based on a common understanding of behaviours and values as well as technology requirements.

Aberdeen's Sustainable Energy Action Plan (Powering Aberdeen) targets a 50% reduction in greenhouse gases by 2030 (compared to 2005 baseline), as well as a renewable energy target to generate the equivalent of 100% of gross annual electricity consumption and 11% of heat consumption by 2020.

As part of the city's effort to promote citizen engagement and social inclusion, Aberdeen has an extensive citizens panel (Aberdeen Voice) covering a representative sample of all demographics who participate in both digital and real-world engagement to help the Council and partners identify the issues and inform the solutions to city challenges.

4.2.10.3 Key Initiatives and Projects

Renewable energy and energy efficiency are major areas of focus for Aberdeen. Launched in 2001, The Aberdeen Renewable Energy Group is a public-private partnership (P3) with over 160 members that seeks to initiate and deliver large renewable projects. The city has a number of initiatives underway, including offshore wind farms, local onshore wind applications, solar installations on public buildings (over 90 solar PV systems installed), and the city's first community renewables project called Donside Hydro. The city is building a European Offshore Wind Deployment Centre off the coast of Aberdeen to accelerate the development of offshore wind power in Scotland, and is also in the process of building an Energy from Waste facility.

The Aberdeen Hydrogen Bus Project is a £20 million partnership with industry and public sector players. Aberdeen currently has the largest hydrogen bus fleet in the UK, with 10 hydrogen-powered buses operating on locally generated renewable hydrogen from two refuelling stations. Another clean transportation initiative is the Co-wheels Car Club – a carsharing programme in Aberdeen with over 1,000 members and roughly 40 vehicles, including a variety of hybrids and EVs.

In terms of digital infrastructure, Aberdeen is developing a new ICT data centre and a citywide smart Wi-Fi network to make broadband widely available to its residents. Free Wi-Fi is now available to the public in 30 Aberdeen City Council buildings. A citywide low power network is currently under deployment and the Aberdeen City Region Deal area has also been selected as one of six pilot areas for the roll out of DCMS full-fibre voucher assistance for businesses. Delivery of Europe's first large-scale, multi-operator, small-cell mobile network has been completed and is under testing prior to a public launch during September. Aberdeen is also one of four Scottish cities selected to pilot the SCA Intelligent Street Lighting programme, supported by a £2.8 million grant from the ERDF.

The Council is in the process of creating a new citywide open data portal to be operational by the end of 2017. The hope is that, by working with partners, this will also enable a city information exchange across the public and private sector to stimulate innovation in commercial and public sector solutions.

Aberdeen is part of a consortium delivering the Civitas PORTIS project. This 4 year, Horizon 2020 project that will test innovative and sustainable urban mobility solutions in five European port cities (alongside Antwerp, Trieste, Klaipeda, and Constanta). Ningbo, in China, is also involved as a follower city. The project aims to show that sustainable urban mobility can increase functional and social cohesion between city centres and ports, whilst improving the economy and attractiveness of urban environments.

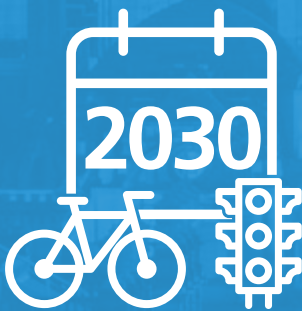
4.2.11

EDINBURGH

4.2.11.1 Summary

The future vision for Edinburgh has been laid out in Edinburgh Council's Transport 2030 Vision and in the 2050 Edinburgh City Vision currently under development. In addition, Edinburgh is working with other Scottish cities on the combined development of a Scottish city blueprint as part of Smart Cities Scotland. The city has already deployed a range of pilot projects and a digital infrastructure that can enable further innovation. It has an active Living Lab initiative that is also contributing to new perspectives on city operations and services. Executing on its ambitious transportation vision and scaling up its successful smart city pilots will be important factors in meeting the needs of an expanding population.

Key areas of focus:



Transport 2030 Vision



Edinburgh Living Lab



Smart waste management project

61.3

Overall Score

64.6

Strategy

57.9

Execution

4.2.11.2 Strategy

Edinburgh, the capital of Scotland, is one of the fastest growing cities in the UK. It is striving to be the most connected, creative and inclusive entrepreneurial city in Europe. Edinburgh has made several areas of investment a strategic priority, including infrastructure, innovation hubs, housing, culture and tourism, and cross-cutting programmes such as inclusive growth and skills, and digital and low carbon technologies.

Several city-led initiatives are underway. Edinburgh Council's Transport 2030 Vision is a strategy to make the city's transportation system one of the greenest, healthiest, and most accessible in Northern Europe. Additionally, the 2050 Edinburgh City Vision serves as a long-term strategy for future life in the city. The project opened submissions from the public to create a citywide conversation about the long-term future of Edinburgh – focusing on people, the environment, and the economy. Thus far, the city has received over 5,700 idea submissions and will be holding events and workshops to further develop the vision before it is finalised.

In addition, Edinburgh is working with Smart Cities Scotland, one of the Scottish Cities Alliance (SCA) programme workstreams, to coordinate its urban innovation programme with Scotland's other six cities and to collaborate on several smart city projects.

4.2.11.3 Key Initiatives and Projects

Edinburgh is developing a wide variety of projects through the Smart Cities Scotland workstream. In the city operations sector, the city is working collaboratively with Perth, Dundee, Glasgow, and Stirling to deliver smart waste technologies. Smart bins are being deployed to enable improved waste management services, increase efficiency in garbage collection, and enhance recycling techniques. Intelligent lighting pilots and CCTV cameras are also being deployed. In the transport sector, the Edinburgh Bustracker API is a web service that delivers real-time bus information for the Edinburgh area. The API delivers information to users on routes, destinations, bus stops, and service disruptions.

Other measures outlined in Edinburgh's Transport 2030 Vision include:

- **Environmentally friendly:** Work towards an emissions-free public transport fleet by supporting initiatives for electric and hybrid vehicles, parking permit changes based on vehicle emissions, green procurement for council fleet vehicles, and air quality improvements in partnership with the freight industry.
- **Healthy:** Increase investment in cycling infrastructure, improve conditions for pedestrians, promote active and smart travel through travel planning programmes, low emission zones, active traffic management to mitigate high pollution areas.
- **Accessible:** Expansion of Park and Ride programme, increased public transport capacity including potential expansion of tram network, high speed rail, and engagement with freight sector to increase flow of goods and services.

The Transport 2030 Vision also includes measures to make Edinburgh's transport system smarter and safer through measures such as intelligent traffic control systems, integrated ticketing, and greater use of CCTV and lighting.

Alongside Digital Scotland, the Scottish government has also deployed several pilot projects in Edinburgh through the Demonstrating Digital programme (over £400,000 funding to date). These pilots include the support of housing associations to develop affordable broadband services for digitally excluded tenants, and telehealth support for the University of Edinburgh to demonstrate point-to-point wireless links utilising free space optics and 24 GHz microwave technology.

The Edinburgh Living Lab is a citywide collaboration founded by the City of Edinburgh and the University of Edinburgh. The goal of the Living Lab is to explore new approaches to innovation, sustainable development, and policy making through data-driven analysis and participatory research (small-scale experiments with citizen end users). It is interdisciplinary, though mobility and energy are major focuses of the program. Within the mobility space, the Living Lab has conducted an electric taxi feasibility study, and analysed walking and cycling data to promote active travel. Energy management in public sector buildings and energy data access for all are significant initiatives within the Lab's energy division.

In terms of civic engagement, EdinburghApps is an annual challenge as part of the City Council's civic challenge programme. Launched in 2013, it was the first event of its kind in the UK – aiming to provide creative and customer-driven solutions to city challenges. One of the finalist apps from 2016 was an app called #agameofwalks, which encourages residents to travel by foot, bike, or public transport through gamification. Addiction Recovery Companion (ARC), an app to support those in early recovery from drug or alcohol addiction. Co-designed by a new company working with the council service and its clients, the app has attracted attention from health and local government bodies across the UK.

4.2.12

NEWCASTLE

4.2.12.1 Summary

Newcastle University has been a driving force behind Newcastle's smart city innovation programmes. Working with Newcastle City Council and other partners, it is coordinating and facilitating a portfolio of innovations projects that span digitalization of the council, innovation in city services, and smart infrastructure. Newcastle was a pathfinder for city deals and the devolution of power to cities. It was also one of the leaders in the developing a sustainable city programme. The city is now pressing forward again with a refreshed vision and unique partnership model to accelerate the adoption of smart, clean, and digital technologies.

Key areas of focus:



Urban Living Partnership



Science Central



Digital Civics programme

58.8

Overall Score

64.0

Strategy

53.0

Execution

4.2.12.1 Strategy

A city containing more than 380,000 citizens and merging with areas encompassing over 1 million people, Newcastle faces numerous social and economic challenges, but it is also the fastest growing region outside London for digital and technology employment with 30,000 employed in the sector. Newcastle's smart city initiatives focus on identifying solutions for its major challenges and boosting its aim to be a leading city for science and digital technology.

Newcastle University and Newcastle City Council are together developing Science Central, a £350 million flagship project bringing together academia, the public sector, communities, business, and industry to create a global centre for urban innovation. Science Central is providing a space for many of Newcastle's smart city initiatives to be tested and developed. Newcastle City Council published its Digital Technology Plan in 2017.

Newcastle City Futures (NCF) is also now at the forefront of progressing smart and socially inclusive city initiatives across the city. Newcastle University led the establishment of NCF in 2014 as a collaborative platform to bring together Research and Development potential with long term policy trends and business needs in the city. NCF is part of a broader network of special purpose vehicles including the city council's City Futures Development Group, the Science City Partnership Board, and Newcastle 2020, which bring researchers, businesses and municipal government together to address future challenges of the city.

In May 2016, NCF further scaled up its activities to become one of five Urban Living Partnership (ULP) pilots funded with £1.2 million from Research Councils UK and Innovate UK. NCF now comprises over 160 partners covering public, private, and third-party sectors in the city, prioritizing themes for Newcastle to be a Digital City; an Age-Friendly City; a Scientific City; and a Cultural City. Over 50 cross-sectoral, multi-partnered innovation projects are now being developed, brokered by the university, by facilitating pilots and proof of concept approaches.

4.2.12.2 Key Initiatives and Projects

Over the past 18 months, Newcastle has invested significantly in new centres within the Science Central campus, including the government-funded £40million National Innovation Centre for Ageing Science, the £30 million National Innovation Centre for Smart Data Institute, and a £10 million National Centre for Energy Systems Integration.

Adjacent to the centres, Newcastle University has opened its Urban Sciences Building, a £60m centre for digital, data and visualisation, at the heart of the city's new Innovation District, Science Central. A new £20 million Newcastle Laboratory will be also completed in 2018. The USB is the home for the Digital Institute, the Cloud Computing CDT, Open Lab, and the Urban Observatory and aims to accelerate innovation with businesses in and beyond the region.

More than £8m in Research Council grants has also been awarded to Open Lab to create a Digital Civics programme involving 60 PhD digital and public service students and a Digital Economy Research Centre to support project delivery across the city. More widely across the city, a £1 billion investment strategy for the Metro and £200 million for investment in the airport have also been announced.

Newcastle University's Smart City project utilizes different Science Central labs to support 4 major projects, including a Smart Energy Network, Local Energy Supply, Green Flood Management, and Integrated Transport. These labs have capabilities for gathering and processing data from digital sensors and creating models for determining the impact of different technologies, which has enabled more efficient use of grid assets, outage detection, development of local microgrids, big data applications, flood reduction, cooperation between businesses, electric vehicle support, transportation planning, and tracking cycling benefits.

The NCF innovation projects include: Future Homes, Metro Futures, and Future High Street:

- **The Future Homes** project aims to develop new digitally-enabled housing that show how one home can combine innovations in flexible living, materials, digital technology, and zero-to-low energy systems for support throughout the lifecycle. In December 2016, the Homes and Community Agency awarded the Future Homes project with £1.12 million to construct four demonstrator units in Newcastle.
- **The Metro Futures** project created a digital engagement platform that attracted 3000 citizen participants shaping the design of their city's new metro cars for accessibility and mobility to inform a bid by Nexus to the Department for Transport in February 2017.
- **Future High Street** aims to redesign Newcastle's city centre by deploying digital retailing and green infrastructure that links customers to businesses, and creates a more vibrant and fun environment.

Newcastle and Gateshead have together been awarded The Great Exhibition of the North 2018 by the UK government. The event will span 77 days in the summer, and digital and creativity will be a principal theme for new installations to be showcased across the city.

4.3.1 BELFAST

4.3.1.1 Summary

With the development of the Smart Belfast framework, Belfast is developing a more coordinated vision of its evolution to a smarter city. Drawing on existing investment in the digital sector and strengthening collaboration with city partners and local universities should provide a foundation for significant acceleration of innovation in city services and infrastructure.

Key areas of focus:



Smart Belfast framework



Smart Belfast
Collaborative Challenge



Machine learning project for
Land and Property Services

50.4

Overall Score

55.0

Strategy

45.4

Execution

4.3.1.2 Strategy

Belfast City Council has been working with the city's partners and the Future Cities Catapult to develop a Smart Belfast framework that will lay the basis for its smart city programme. The aim is to build on the city's strengths in the digital sector to develop additional collaboration and innovation between local businesses, universities, and the public sector.

The Smart Belfast framework aims to develop the city's capabilities in four areas:

- **A shared understanding of the city's challenges:** Working with partners to find new ways to collaborate and address problems.
- **Engagement with the innovation community:** Co-opting the local SME sector and universities to tackle challenges together.
- **Building city data assets:** Working with partners to understand how data can be better generated, managed, and accessed to develop new products and services.
- **Developing robust delivery mechanisms:** Helping city partners find new ways to attract investment and to support the development, testing, and rapid scaling of successful innovations.

4.3.1.3 Key Initiatives and Projects

Belfast has already supported several projects to improve the gathering and use of data to improve city services and capabilities. For example, it ran a successful Small Business Research Initiative (SBRI) competition that identified machine-learning and other data analytics solutions to assist Land and Property Services to find sources of non-domestic rates income for the region.

Belfast has worked with the Futures Cities Catapult to develop a web-based tool to identify the capacity of major infrastructure systems across the city. Over time, this is likely to include capacity details for energy, water, and digital infrastructure. The city is also looking to develop a city dashboard to start monitoring various aspects of the city, including outcomes for health, economy, or sustainable development. The city has also invested in its infrastructure, and currently has 100 public buildings with public Wi-Fi and is deploying Wi-Fi to outdoor areas in the city centre.

The Smart Belfast Collaborative Challenge with Invest NI will be launched in late September 2017. This will provide initial funding for up to eight networks seeking to explore innovation in the areas of urban transport, visitor experience, the circular economy, active living, and the management of the public estate. More substantial funding may be available for proposals that show significant potential.

Belfast has been a pioneer in telemedicine and health technologies. The European Centre for Connected Health (ECCH) – now known as Centre for Connected Health and Social Care – was established in 2008. The Centre promotes improvements in patient care using new technologies, and fast-tracks new products and innovation in the Health and Social Care system in Northern Ireland.

4.3.2

SHEFFIELD

4.3.2.1 Summary

Sheffield is making gradual progress in the development of its smart city vision. An initial consultation on the Sheffield Plan: City-Wide Options for Growth to 2034 suggested digital and technical innovations needed to support a smart city vision. The city has made strides in developing this plan further and implementing pilot city projects with a digital focus. There continues to be opportunity for the city to make stronger links between its broader strategy and the potential for smart city innovations, as is being explored in the Smart City Lab. Clearer leadership and coordination across Sheffield's smart city activities is still needed to strengthen its smart city brand.

Key areas of focus:



Sheffield Smart Lab



Sheffield Green Commission



Tackling air pollution - Sheffield AirMap

47.4

Overall Score

49.1

Strategy

45.6

Execution

4.3.2.2 Strategy

A city with a long history as an industrial centre, Sheffield has a population of over 560,000 today. The Sheffield City Council launched an initiative in late 2015 to develop a plan for the city that looks forward 15-20 years until 2034. It targets a growing population and the need for improved transport, housing, and sustainable energy. Digital connectivity is identified as a key enabler, along with education and training to develop the workforce. A Consultation Report is expected to be available in autumn 2017 to launch consultation on the policies and proposals contained in the draft Sheffield Plan. The target is to have an action plan adopted in 2019.

The Sheffield Plan will likely be informed by the city's sustainability plan. In 2016, the Sheffield Green Commission issued its final report on Sheffield's Green Commitment, summarising a 12-month consultation on how the city can move towards becoming more sustainable. The report is centred around four themes: Connected City, Transformative Energy, European Green City, and Learning City. In March 2017, the Sheffield City Council published a five-point sustainability plan, Growing Sustainably: A Bold Plan for a Sustainable Sheffield, in response to the Green Commission's final report. The city council is now undertaking a comprehensive gap analysis to develop an action plan to carry forward its sustainability strategy.

4.3.2.3 Key Initiatives and Projects

The Sheffield Smart Lab is a project run by city council and service partners, Ferrovial and Amey, to establish Sheffield as a centre for urban innovation by identifying, developing, and piloting new solutions to city challenges. The programme also aims to encourage and support entrepreneurs in Sheffield and raise the city profile as an ideal test bed for developing smart solutions to tough city issues. The lab's two initial challenges focused on rejuvenating and making the city centre more dynamic and supporting independent living for housebound citizens. Nine winning solutions were selected from more than 50 proposals received from 10 different countries. The startups had the opportunity to participate in an incubation and acceleration programme to develop and test their ideas and business models in an innovation centre supported by the University of Sheffield and Sheffield Hallam University.

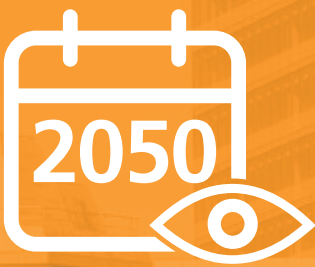
Sheffield is also making progress in establishing an open data platform, which currently hosts around 100 city datasets. The city has also hosted several events to promote the creative use of data to improve service delivery in the city. The Air Quality+ initiative, developed in partnership with the Better With Data Society (a local open data community), aims to engage the community in creating a data-driven ambition and datasets for air quality in Sheffield. The resulting Sheffield AirMap provides real-time information within a defined Air Quality Management area, increases awareness, and promotes activities that contribute to better air quality and environmental efficiency.

4.3.3 READING

4.3.3.1 Summary

Reading is well-placed to utilise local connections to support its development as a smart city. The vision for Reading 2050 outlines the possibilities for the town and local region and is spurring a series of innovation projects across multiple sectors. Realising the ambitious goals set out in the vision will require Reading 2050 to become more embedded in the city's operations, services, and strategy.

Key areas of focus:



Reading 2050 Vision



Thames Valley Vision
low carbon project



Real-Time Open Data
Information System

45.1

Overall Score

50.2

Strategy

39.3

Execution

4.3.3.2 Strategy

With a population of approximately 233,000 inhabitants at the core, Reading is considered one of the leading digital economies of the UK, situated as it is in the heart of the UK's technology sector along the M4 corridor.

The Reading 2050 Vision will be launched in October 2017. The document will outline a plan to make Reading a smart and sustainable city by 2050: "a city where low carbon living is the norm, and the built environment, technology, and innovation have combined to create a dynamic, smart, and sustainable city with a high quality of life and equal opportunities for all." This is a private, sector-led initiative by Reading UK, the economic development and marketing company for the town with lead partners Barton Wilmore, an independent national planning and design company and the University of Reading, with support from Reading Borough Council. The Reading 2050 has already been written into the draft consultation Reading Local Plan.

The Reading 2050 Vision is based on a 3-year exercise that involved engagement with 21,000 members of the local community and some 350 local business representatives, as well as 15 events. More than 50 ideas have been taken from the workshops to provide the basis for further discussion and action, and a set of vision statements have been established to communicate how Reading will evolve in the future and to measure progress.

The vision embodies three interrelated themes to help focus and manage future work streams:

- Reading: A City of Green technology
- Reading: A City of Culture and Diversity
- Reading: A City of Rivers and Parks

In addition to the Reading 2050 Vision, a climate action plan for Reading for 2013-2020 has been outlined by the Reading Climate Change Partnership – a group including the council, universities, NHS, and local businesses and community organisations. This sets targets for a range of environmental programmes, including energy consumption, waste reduction, and water management.

4.3.3.3 Key Initiatives and Projects

Thames Valley Berkshire LEP has funded a Smart City Network involving Reading, Bracknell, and Newbury. Led by Reading Borough Council, it plans to develop new capital-based energy and mobility projects. This will complement other local smart energy projects, including the new hydro scheme at Caversham Weir. Led by Scottish and Southern Energy Power Distribution in partnership with University of Reading, the continuing Thames Valley Vision low carbon project is trialling smart grid solutions, smart meters, in-home displays, and renewable energy generation technologies.

The University of Reading's School of Built Environment has developed a virtual and a 3D physical model of Reading, with further plans to develop an urban room, celebrating the past, present, and future of Reading. In partnership with a range of research partners, the university is developing further funding bids for projects that build on the Reading 2050 work, based on, for example, modelling urban metabolism and designing tools for improved planning and decision support for socio-environmental change to 2050.

Transport is another focus area. The city transport strategy includes the deployment of the Reading smart transport card, a comprehensive cycle network; and a rapid transit system to connect the city from east to west and from north to south, relieving congestion in the town centre. As parallel with these developments, the council has also been proactive in making transport network data available to developers.

Reading's Real-Time Open Data Information System provides access to an extensive range of data from the regional travel network. API are provided to enable developers to use the data for the development of new services and applications.

In January 2017, Reading Buses, the group managing the city's public bus service, launched its contactless pay system and mobile ticketing and bus information app. Buses now accept contactless bank card payments and direct debits for smart card holders. The company has also deployed what is claimed to be the world's first compressed natural gas operated bus coming from a certified carbon neutral bio-methane source.

The city is promoting business incubation units called Ideas Factories, as well as the use of Reading University's city centre campus to exhibit and test innovative ideas and approaches. Other planned projects include retrofitting existing buildings and the development of iconic architecture to provide some of the greenest accommodation possible for incoming businesses. To support further innovation in the city, the council and the University of Reading joined forces to launch a science park to attract new digital business to the region and better support local startups.

4.3.4 LIVERPOOL

4.3.4.1 Summary

Liverpool's work on smart and clean energy projects, its health research facilities, and its support for the growth of the local digital sector provide a good base for its developing smart city programme. The challenge now is to pull these pieces together in a more coordinated programme and to formalise some of the developing collaboration networks spanning the public, private, and university sectors.

Key areas of focus:



Rethinking city energy
and renewable energy hub



Health innovation centre



AI-based Emergency
Traffic Control pilot

41.9

Overall Score

48.0

Strategy

34.8

Execution

4.3.4.2 Strategy

Liverpool is a city of 485,000 people and sits at the heart of region of 1.7 million people and an economy worth almost £30 billion. After a long period of population decline, the city's population is once again growing. Liverpool's 2016 City Region Growth Strategy focuses on key sectors such as advanced manufacturing, digital services, financial and professional services, health and life sciences, low carbon energy, maritime and logistics, and the visitor economy. The strategy aims to create an additional 100,000 jobs in the Liverpool City Region by 2040.

Liverpool has developed several smart city initiatives without establishing a formal overarching programme or leadership board. The city has appointed a mayoral lead for smart cities in James Noakes, who is also an elected member. Further developments at the strategic level are expected in the near future to formalise recent consultations. It is also undertaking a benchmarking exercise to help direct and focus its future smart city initiatives.

Initial smart city projects have focused on the city's economic growth areas and also on priority service issues such as the provision of social care. Another area of focus has been innovation in the energy sector. The city is looking to address issues associated with fuel poverty and also to reduce city emissions. It is also supporting the growing cleantech sector, boosted by the presence of the world-leading Burbo Bank offshore wind farm in Liverpool Bay and the potential for tidal energy projects in the Mersey, which has one of the largest tidal ranges in the country.

The city is looking to improve its broadband and wireless communication infrastructure, including expanding its fibre infrastructure, improving Wi-Fi coverage, and deploying a low powered network to catalyse the take-up and development of IoT projects in the city. This is part of a broader ambition to make Liverpool a chosen destination for organisations looking to deploy urban innovation solutions.

4.3.4.3 Key Initiatives and Projects

The city has initiated a range of smart energy programs including street lighting upgrades, building energy management and the CHP systems in public buildings. These have helped it to be ahead of its target to reduce emissions by 35% by 2020 on a 2012 baseline.

Providing affordable energy for low income residents is a priority for Liverpool. Initiatives include the Merseyside collective switching scheme, Energy Projects Plus (environmental charity providing energy advice, training, and education), and the Health Through Warmth programme (help with heating and insulation for low income households) are all supported by the Liverpool City Council. The city has also developed its own local non-profit energy company called the Liverpool Energy Community Company (LECCY), a partnership with Nottingham's Robin Hood Energy, which also includes a smart meter rollout.

Liverpool is home to one of the most innovative offshore wind developments in the world. The Burbo Bank offshore wind farm (off Liverpool Bay) generates enough power for 230,000 homes, using the world's largest wind turbines. As of the end of 2016, Liverpool was home to over 1,200 low carbon businesses employing over 26,000 people.

The Liverpool-based design and technology company, Red Ninja, is working with the city on a trial programme for intelligent traffic light management. Life First Emergency Traffic Control (LiFE) uses artificial intelligence to analyse traffic and journey data to improve the response rate for emergency response vehicles through congested roads. The team has developed an application that can manipulate traffic in almost real-time through traffic light control. Ambulances are then able to reach emergency cases more quickly by integrating route-finder applications with city traffic management systems.

Red Ninja also worked with Merseytravel, the local public transport company, to conduct a public transport monitoring project. The project used smartphone data to analyse pedestrian travel patterns and the use of transit systems in order make improvements to public transport routes and scheduling.

Health innovation is another major focus in Liverpool. The Innovation Hub at the renowned Alder Hey Children's Hospital is a centre for advanced research in many areas. Liverpool City Region's e-Health Cluster is also the only SME-led e-Health Cluster in the UK.

Supported by a £5 million award from the European Regional Development Fund (ERDF), a high tech sensor hub has been established in the city centre. The £15 million Sensor City facility, is a JV between the University of Liverpool and Liverpool John Moores University. It aims to make Liverpool a world-recognised centre for sensor technologies.

4.4.1 CARDIFF

4.4.1.1 Summary

With its new city deal, Cardiff has the potential to develop and support an extensive smart city strategy. It is yet to be seen if and how that might evolve. Cardiff's ambitious smart parking project shows there is an appetite to deploy innovative technology to meet city challenges. However, at present it lacks a cohesive and visible programme for smart city and digital innovation.

Key areas of focus:



Cardiff Capital
Region City Deal



Smart parking programme



Regional hi-tech cluster

25.5

Overall Score

27.2

Strategy

23.8

Execution

4.4.1.2 Strategy

Cardiff is the capital of and largest city in Wales, and the eleventh-largest city in the UK with around 346,000 inhabitants. The city's population is expanding rapidly and is expected to grow between 15% and 20% over the next decade.

In March 2017, the Welsh government announced a new £1.2 billion City Deal for Cardiff to unlock significant economic growth across the region. Over its lifetime, local partners expect the City Deal to create 25,000 new jobs and attract an additional £4 billion in private investment. The aims of the CCR City Deal are to “create jobs and boost economic prosperity by improving productivity, tackle unemployment, build on foundations of innovation, invest in physical and digital infrastructure, provide support for business, and ensure that any economic benefits generated as a result are felt across the region.”

The City Deal includes the 10 local authorities of Blaenau Gwent, Bridgend, Caerphilly, Cardiff, Merthyr Tydfil, Monmouthshire, Newport, Rhondda Cynon Taf, Torfaen, and the Vale of Glamorgan. Cardiff Capital Region is working with the UK government and the Welsh government to develop a joint implementation plan.

The Cardiff Capital Region Transition Plan details key initiatives of the City Deal, including the establishment of a Regional Office to drive the delivery of the work programme, in anticipation of receiving proposals. The Regional Office will select the most promising proposals from the community based on a bespoke impact assessment model that emphasises economic benefits and impacts.

4.4.1.3 Key Initiatives and Projects

The CCR Regional cabinet has already earmarked £37.9 million to support development of a new Compound Semiconductor Applications cluster located in South Wales. The funding comes from CCR's City Deal's Wider Investment Fund, and is the first investment announced since the signing of the City Deal. The project is expected to attract an additional £375 million from the private sector and create up to 2,000 high technology jobs and hundreds more in the wider supply chain. The high tech cluster is already gaining significant traction, with a recent slate of R&D awards and contract wins by businesses and academic institutions based in the area.

A successful smart city initiative, independent of the City Deal, is a smart parking project executed jointly by Cardiff City Council and Smart Parking Ltd. In February 2017, over 3,000 infrared vehicle detection sensors were installed in on-street and off-street locations throughout the city. The deployment included dynamic signage directing motorists to available parking, and a smartphone app offering real-time parking availability and guidance. Back office processing and analysis platform, SmartRep, provides real-time parking space occupancy on a live map. This project follows a successful pilot in 2015 that covered 275 bays across the city.

4.4.2 EXETER

4.4.2.1 Summary

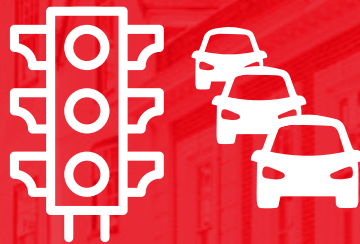
Driven by a loose confederation of organisations, Exeter is in the early stages of developing a smart city program. The Council is working with Exeter City Futures and others on a number of projects and has also set out an ambitious environmental program. The development of a regional programme to address transport and environmental issues will provide greater scale for a range of initiatives. As one of the fastest growing cities in the UK, it will be increasingly important for Exeter to address these issues in innovative ways.

Key areas of focus:



Exeter City Futures
- Urban Impact Accelerator

23.4
Overall Score



Engaged Smart
Transport project

25.9
Strategy



Renewable energy and district
heating low carbon projects

20.6
Execution

4.4.2.2 Strategy

In January 2017, Exeter was named the fastest growing city in the UK. Its economic region is prospering and the local development framework outlines ambitious plans for growth. Currently, the population is 124,000, with a travel to work area population of 280,000, a shopping catchment of over 500,000, and 2,000,000 visitors each year. The city is also attracting 37,168 inward commuters, which strains the city's transportation system. The Greater Exeter economic region spends £914 million per year on energy, almost half of which is attributed to transportation. These challenges are the basis for a smart city strategy that focuses on energy and transportation.

Many of Exeter's smart city initiatives stem from Exeter City Futures, a community interest company (CIC) established by Oxygen House Investments in partnership with Exeter City Council. This smart city venture was founded in November 2015 with the goal of making Exeter congestion free and energy independent by 2025.

4.4.2.3 Key Initiatives and Projects

Exeter City Council has partnered with Devon County Council to launch a smart transportation project called Engaged Smart Transport. The project uses real-time traffic and weather sensor data to understand people's travel behaviour. The councils have partnered with NTT Data, an IT service provider specialising in smart transportation, to manage the program. The project also involves a consortium of members including: University of Exeter, which will provide behavioural research; Black Swan, a big data specialist that will provide trend analysis and prediction, as well as social media engagement; Imtech Traffic & Infra, which will provide its intelligent transportation systems; and Vaisala, which will provide environmental sensors that collect data on road conditions and weather. The project began at the end of 2015, and is expected to run for 2 years.

Exeter City Futures has laid out eight major challenges faced by the city, including increasing bicycle commutes, low carbon housing stock, reducing traffic flow, halving heavy-load vehicles, reducing Exeter's energy consumption, exploring alternative energy sources, increasing active transportation, and on-demand shared mobility. To solve these challenges, Exeter City Futures set up the Urban Impact Accelerator, which aims to connect with entrepreneurs and help them build businesses and social enterprises that deliver Exeter's goal of becoming congestion free and energy independent. The Accelerator grants up to £15,000 to teams chosen to solve Exeter's Challenges, and provides support such as one-on-one coaching and investor interaction. The 15-week programme concludes in a Demo Day, where teams have a chance to pitch their ideas to investors for up to £200,000 and receive ongoing funding opportunities and support. Currently, several challenges have been allocated to Accelerator teams; Exeter's Energy Consumption Challenge has accepted applications and teams are being reviewed; and increasing bicycle commutes, low carbon housing stock, and reducing traffic flow are opportunities that will be available to Accelerator teams in the future.

Exeter City Futures' is also developing education projects with schools to teach students to analyse data from the Exeter City Council and sustainability projects that help local businesses cut emissions and become more energy efficient.

Exeter's sustainability goals are driven by a group called Exeter & East Devon Growth Point, which focuses on the nexus between economic growth and sustainability. Though many of the Growth Point's projects are specifically related to expanding green spaces and parks in the region, the group has also evaluated its sustainability goals based on analysis of its emissions. In response to this evaluation and the national government targets for sustainability, the Growth Point group has identified several key commitments for the city. These include designing and building all dwellings to the government's Code for Sustainable Homes Level 4 and above, and exceeding the BREEAM rating of Very Good for non-residential developments. The Growth Point has also set energy targets, which include producing 16.7% of the new community's energy from renewable sources and producing 10% of non-residential developments' energy from renewable sources.

4.5 Summary of City Scores

Table 4.1 - The UK Smart Cities Index Overall Scores

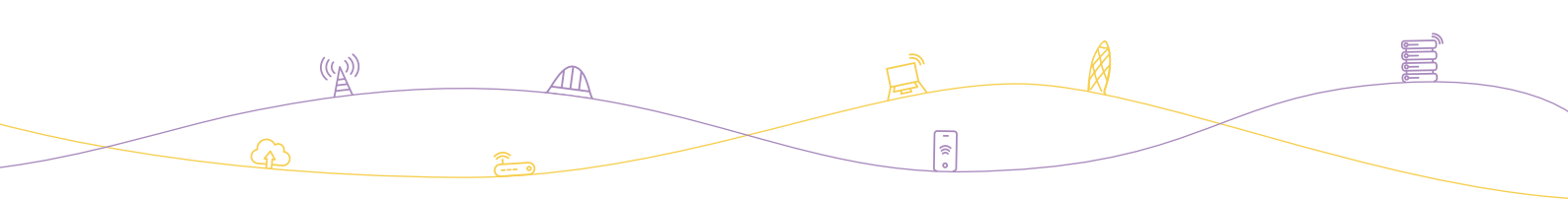
Rank	Company	Score
1	Bristol	82.7
2	London	81.2
3	Manchester	74.3
4	Birmingham	74.2
5	Leeds	74.0
6	Milton Keynes	73.5
7	Glasgow	71.9
8	Nottingham	69.5
9	Peterborough	65.1
10	Cambridge	63.1
11	Oxford	62.6
12	Aberdeen	62.5
13	Edinburgh	61.3
14	Newcastle	58.8
15	Belfast	50.4
16	Sheffield	47.4
17	Reading	45.1
18	Liverpool	41.9
19	Cardiff	25.5
20	Exeter	23.4

Source: Navigant Research

Figure 4.1 - City Scores on Strategy and Execution Criteria

		Aberdeen	Belfast	Birmingham	Bristol	Cambridge	Cardiff	Edinburgh	Exeter	Glasgow	Leeds	Liverpool	London	Manchester	Milton Keynes	Newcastle	Nottingham	Oxford	Peterborough	Reading	Sheffield
Strategy	Assigned Weight	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score
Smart City Vision	20%	80.0	46.0	86.0	90.0	70.0	22.0	60.0	20.0	70.0	70.0	38.0	82.0	78.0	78.0	70.0	64.0	62.0	74.0	44.0	32.0
Digital Innovation	30%	66.0	52.0	80.0	88.0	68.0	24.0	64.0	28.0	70.0	82.0	40.0	88.0	76.0	80.0	60.0	66.0	64.0	66.0	52.0	56.0
Service Innovation	30%	60.0	64.0	68.0	74.0	64.0	32.0	62.0	24.0	72.0	72.0	58.0	72.0	66.0	68.0	60.0	66.0	64.0	60.0	50.0	48.0
Sustainability Goals	10%	80.0	50.0	72.5	77.5	57.5	25.0	75.0	32.5	70.0	70.0	60.0	82.5	72.5	75.0	57.5	85.0	65.0	77.5	55.0	62.5
Stakeholder Engagement	10%	70.0	60.0	87.5	87.5	75.0	35.0	72.5	30.0	72.5	80.0	50.0	82.5	82.5	82.5	82.5	67.5	75.0	70.0	52.5	52.5
Total	100%	68.8	55.0	77.6	83.1	66.9	27.2	64.6	25.9	70.9	75.2	48.0	80.9	73.7	75.8	64.0	67.7	64.8	67.4	50.2	49.1
Execution	Assigned Weight	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score
Implementation	20%	66.7	36.7	80.0	83.3	53.3	20.0	53.3	20.0	83.3	76.7	33.3	86.7	70.0	76.7	53.3	83.3	53.3	76.7	30.0	36.7
Digital Delivery	30%	50.0	43.3	76.7	93.3	70.0	23.3	60.0	16.7	73.3	76.7	30.0	86.7	83.3	76.7	50.0	66.7	66.7	63.3	40.0	43.3
Service Delivery	30%	47.5	52.5	57.5	72.5	52.5	22.5	57.5	22.5	70.0	67.5	32.5	72.5	67.5	62.5	52.5	67.5	57.5	55.0	40.0	50.0
Environmental Impact	10%	65.0	40.0	57.5	72.5	47.5	30.0	60.0	25.0	60.0	65.0	60.0	75.0	70.0	70.0	52.5	77.5	55.0	60.0	50.0	52.5
Community Reach	10%	63.3	53.3	86.7	86.7	70.0	30.0	60.0	23.3	73.3	76.7	33.3	90.0	86.7	70.0	63.3	66.7	70.0	60.0	43.3	50.0
Total	100%	55.4	45.4	70.7	82.3	59.2	23.8	57.9	20.6	73.0	72.8	34.8	81.6	74.9	71.1	53.0	71.3	60.4	62.8	39.3	45.6

Source: Navigant Research



SECTION 5

SCOPE OF STUDY AND METHODOLOGY

5.1 Aims of This Study

The aim of the UK Smart Cities Index is to provide an assessment of the current state of smart city development through a detailed comparison of the 20 leading smart cities. The evaluation highlights their strategies, key projects, and overall readiness to develop their smart city visions. The study also highlights lessons to be learnt from these early adopters and areas where cities, the national government, and other stakeholders need to act to accelerate smart city development in the UK.

Navigant Research has prepared this white paper to provide an independent analysis of the current development of smart cities in the UK. The report is intended for city leaders and managers responsible for smart city projects, government agencies and other bodies supporting cities, and suppliers seeking to better understand the smart city market.

The major objective of this Navigant Research white paper is to provide a timely assessment of the leading cities, including their strategy for smart city development and their execution against that strategy. Note that the city rankings capture the city's standing at the time of the report and are not a retrospective of past accomplishments or an indication of future success. The ratings are likely to change rapidly as cities accelerate their smart city plans and projects.

5.2 Evaluation Method

The 20 cities were selected on the breadth and depth of their smart or future city strategy and specific programmes in areas such as digital innovation, social care, urban mobility, energy, education, and sustainability. The assessment also looks at the extent of their partnerships and collaboration with other agencies and the private sector. A detailed comparison was made of the top 20 cities to identify the current leaders and their closest challengers.

The city evaluations in this report are based on Navigant Research's corpus of smart city research; public documents on city strategies, projects, and performance; interviews with city leaders and project teams; and interviews with other key stakeholders in the development of smart cities from the public and private sector.

5.3 Evaluation Criteria

The city evaluations for this Index are based on two dimensions: Strategy and Execution. The Strategy dimension assesses each city's vision, goals, and objectives as they relate to its smart city programme. The Execution dimension assesses the city's actual achievements from initial projects to full-blown deployment of innovative technologies and services.

Each dimension is split into five evaluation categories. The evaluation categories for the Strategy dimension are as follows:

- **Vision:** Assesses a city's smart or future city strategy, including an assessment of the clarity, comprehensiveness, and depth of the strategy. An assessment was also made of the leadership commitment in each city and the level of engagement with all stakeholders.
- **Digital Innovation:** Assesses a city's strategy to develop and exploit digital technologies and services, including plans for the development of the city's communications infrastructure, its open data policy, digital inclusion strategy, and plans for developing the local digital economy.
- **Service Innovation:** Assesses a city's strategy for innovations in local services that exploit improvements offered by smart technologies, including plans in the areas of council services, social care and healthcare, education and skills, and transport and urban mobility.
- **Sustainability Plans:** Evaluates a city's sustainability strategy and the explicit targets set for energy consumption, greenhouse gas emissions, and related goals in the areas of waste management, transport programs, air quality, and other environmental initiatives.
- **Stakeholder Engagement:** Examines the range of city stakeholders involved in the development of the smart city strategy, including citizen engagement programs, business involvement (particularly local SMEs but also significant partnerships with larger players), and the involvement of local universities and other research organisations.

The evaluation categories for the Execution dimension are:

- **Implementation:** Assesses the city's overall progress in translating its strategy into action based on the number, range, and extent of projects implemented to date. It also assesses forward momentum in terms of projects in process and the near-term pipeline for new projects and programmes.
- **Digital Delivery:** Evaluates progress on implementing the city's digital strategy, including pilot projects, smart city demonstrators, and full-scale projects spanning all forms of digital innovation including IoT projects, open data platforms, and other big data programs, digital inclusion projects, and improvements to the city's communications infrastructure.
- **Service Delivery:** Evaluates progress on implementing service innovations defined in the city's smart city strategy, including improving access to core services, innovative projects for social care and healthcare, improvements in skills and education related to the use of digital technologies, urban mobility innovations, innovations to support local businesses, and programmes aimed at providing improved information and services for visitors and residents.
- **Environmental Impact:** Looks at achievements against sustainability targets and implemented environmental and sustainability programmes, including smart energy projects, low carbon transport initiatives, energy efficiency programmes (such as smart street lighting and smart waste projects), and other environmental programmes.
- **Community Reach:** Assesses the engagement across multiple communities, the involvement of local businesses and academic communities in smart city projects, and the extension of projects into the wider city region and other local agencies.

5.4 The Index Rankings

Navigant Research scored the cities in the UK Smart Cities Index according to four categories: Leaders, Contenders, Challengers, and Followers. These categories are defined below.

5.4.1 Leaders

Leaders are cities that scored 75 or above in both Strategy and Execution. These cities have differentiated themselves through the clarity, breadth, and inclusiveness of their smart city vision and planning. They are also leading the way in implementing significant projects at both the pilot and increasingly full-scale levels.

5.4.2 Contenders

Contenders are cities that scored above 50 in both Strategy and Execution but are not yet Leaders. Whilst these cities have done much to establish their smart city strategy and have implemented some significant projects, there are still some gaps in their strategy, and the number of actual projects may fall behind that of the smart city Leaders.

5.4.3 Challengers

Challengers are cities that scored higher than 25 in both Strategy and Execution but are not yet Contenders for leadership. Whilst these cities have laid down a vision for their smart city endeavours and begun to deploy projects, execution still trails the vision outlined by a significant margin in some areas at least. They may have shown strong initiative in a few key areas but less so across the broader smart city areas.

5.4.4 Followers

Followers are cities that have initiated some smart city projects but have not yet established themselves as leading innovators or developed extensive smart city strategies. They score below 25 in either Strategy or Execution. These cities need to move beyond initial statements of intent and limited pilot projects and siloed operations to develop a more integrated view for city development and/or stronger leadership for their programmes.

5.5 Sources and Methodology

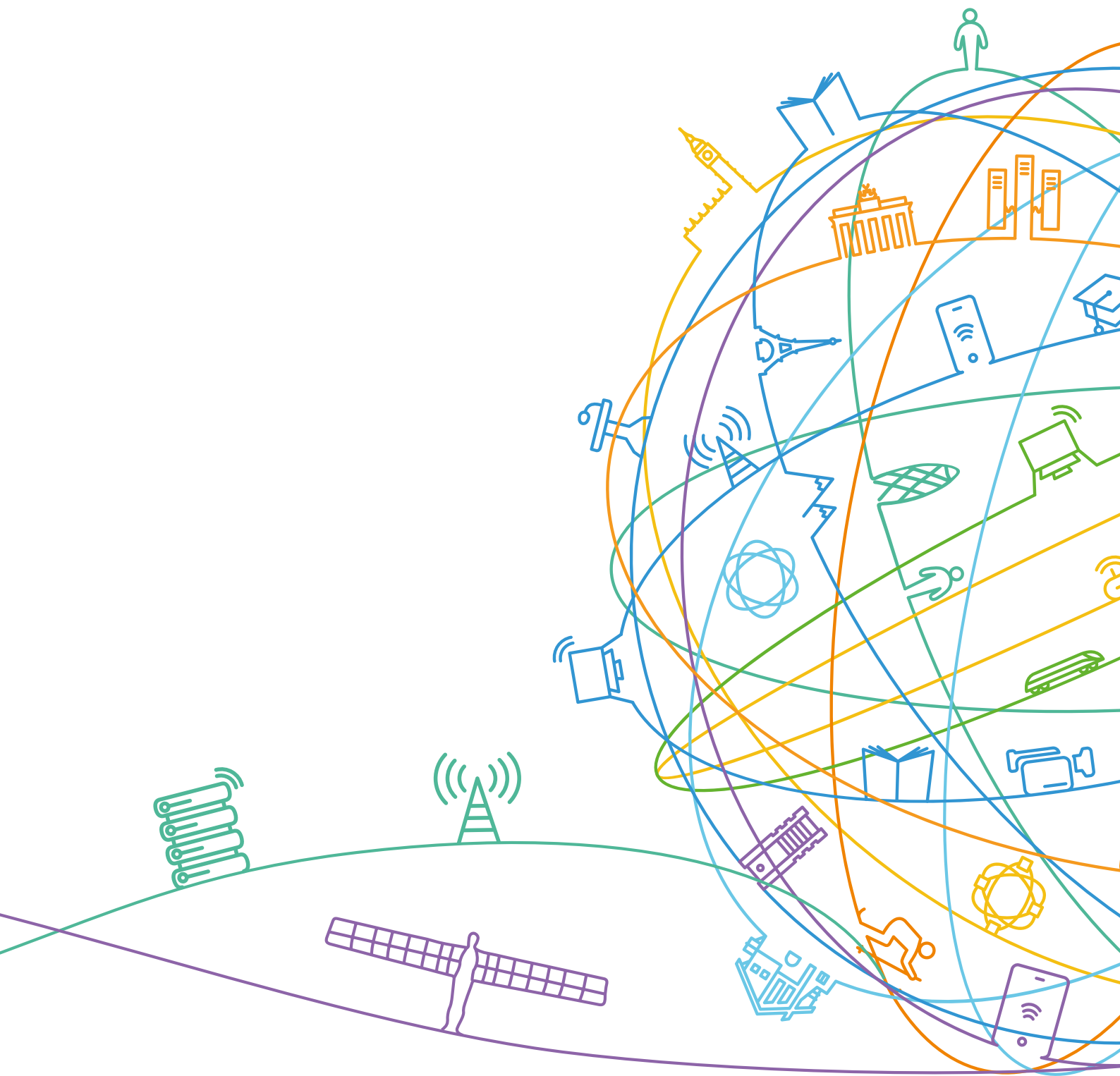
Navigant Research's industry analysts utilise a variety of research sources in preparing Research Reports. The key component of Navigant Research's analysis is primary research gained from phone and in-person interviews with industry leaders including executives, engineers, and marketing professionals. Analysts are diligent in ensuring that they speak with representatives from every part of the value chain, including but not limited to technology companies, utilities and other service providers, industry associations, government agencies, and the investment community.

Additional analysis includes secondary research conducted by Navigant Research's analysts and its staff of research assistants. Where applicable, all secondary research sources are appropriately cited within this report.

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©2017 Navigant Consulting, Inc.
1375 Walnut Street, Suite 100
Boulder, CO 80302 USA
Tel: +1.303.997.7609
<http://www.navigantresearch.com>

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