MAYOR OF LONDON

THE FUTURE OF SMART

Harnessing digital innovation to make London the best city in the world

UPDATE REPORT OF THE SMART LONDON PLAN (2013)

MARCH 2016

MAYOR'S FOREWORD

London is a digital world leader. For some, innovation in technology is about the sheer speed and amount of data we carry with us in our smartphones. Yet it is much more than that. It's about the creativity of our tech entrepreneurs. It is also about the trust Londoners have in digital communication with City Hall and with business.

Our great city has long been at the forefront of new technology. Indeed, back in 1837, William Fothergill Cooke and Charles Wheatstone designed the first operational telegraph system to link Euston Station and Camden Town. This new technology expanded rapidly. In so doing, it made personal communication normal in London and across the world. Our forebears would never have imagined the constant flow of messages both inside and outside London today. But then, nor would we a few years ago. In the Victorian era, the telegraph supported the railways' expansion as London doubled in size in the space of just 30 years.

Today, as we plan for over 10 million citizens in 2036, London is again showing how the power of data and technology can help support growth.

Our tech industry is renowned for its innovation and entrepreneurial energy. That is why investment in the sector is so high – ten times more than just five years ago. We have been working hard at City Hall to open up London's data and build new tools to see how to best deal with our growing capital.

Working closely with Londoners, industry and the Smart London Board, we are doing all we can to ensure London takes advantage of the opportunities presented by technology – both now and in the future. I would like to give a special thanks to the Smart London Board for building and keeping the momentum going.

Two years ago, we published our Smart London Plan. This outlined how we would harness the creative power of new technologies to serve London and improve Londoners' lives. Since then, we have made much progress. However, there is still – and always will be – much more to do if we want London to stay at the bleeding edge of technology. In this report, we take a look at our achievements so far, and set out some big ideas for the future.

Boris Johnson
Mayor of London

CHAIR'S FOREWORD

London is making remarkable progress in deploying digital technology to improve Londoners' lives. More data is available for everyone to use through the London Datastore than in any other city. This is providing insights for citizens, entrepreneurs, firms and government, fuelling the development of many digital businesses.

Major improvements are being made to the city's digital infrastructure and Europe's mega-city is riding high in the 'smart city' league tables.

London's scale, diversity and international reach mean that technology has become even more important, connecting public and private sectors across 32 boroughs and the City in a complex, bustling metropolis.

The Smart London Board advises the Mayor's Office and has been the catalyst for creating smart demonstration projects. The Board is proud of its success in winning new funding for London and for its collaboration with other cities in the UK, Europe and beyond.

Working in partnership with London's universities, Catapults, Tech City, digital businesses and infrastructure providers, we have proven the case for London as a smart city. We have built the foundations to take advantage of the many opportunities to harness the power of the Internet of Things and the Cloud, making data a core part of London's infrastructure. Many other cities look to London as their inspiration. We have a wonderful opportunity to remain at the forefront in deploying the creative power of new technology.

But, we shall need to do more if London is to solve major challenges that lie ahead in housing, transport, environment and skills.

The Smart London Board and the communities it represents and serves stand ready to work with the incoming Mayor on these challenges. Finally, my thanks go to Stephen Lorimer and Sara Kelly who provided wonderful support from within City Hall.

Prof. David Gann CBE,
Vice President (Development and Innovation), Imperial College London and Chair of the Smart London Board

EXECUTIVE SUMMARY

This report looks at the Smart London Board's progress in advising, developing and promoting the use of digital infrastructure and data in London since we published our plan two years ago. It also identifies future opportunities for the next Mayor of London.

We have succeeded in keeping London at the forefront in a data-driven world. We have funded and launched a range of new projects. We have also developed a wide community of participants. However, there is more to be done.

The twin challenges of economic growth and a growing population are putting a strain on London's housing, healthcare and transport infrastructure. The environment remains a challenge, particularly air quality. Technology is changing apace. London can stay ahead by expanding projects like its driverless vehicle programme. In these tough conditions, standing still is not an option.

We must invest more in London's data infrastructure. Doing so will help the city be brilliantly placed to make the most of the Internet of Things. It must be better connected too. That means making super-fast broadband available to everyone in London and investing in digital skills. Our major regeneration projects, like Queen Elizabeth Olympic Park and Old Oak Common must use the best digital infrastructure available. London should also work for common standards across all layers of digital and cyber-physical infrastructure, and between boroughs and City Hall. The Smart London Board identifies the following actions as priorities for the next Mayor:

- *Engaging our citizens – putting Londoners at the core, through wide, inclusive digital engagement, and improving digital skills for all*

- *Enabling good growth – through resilient digital infrastructure, smart homes, making more data available, and investing in innovation*

- *Working with business – breaking down boundaries, supporting common standards, producing smarter regulations, and scaling-up innovation*

City Hall needs to build on its achievements so far. Londoners, businesses and the tech industry also have a role to play. Together we must help the city to harness these opportunities and maintain London's reputation as an engaged, growing, entrepreneurial, tech-savvy city.

This report starts by checking progress against the seven aims of the Smart London Plan. The following three sections look at our how we've engaged our citizens, encouraged good growth, and partnered with London's businesses to use smart technologies to improve our city. Finally, we end by outlining the Smart London Board's nine priorities for the future of 'smart' in London. We hope these are put into action by the next Mayor of London.

Prof. David Gann CBE,
Chair of the Smart London Board

CONTENTS

LONDON
LEADER IN TECHNOLOGY

40,000
TECHNOLOGY FIRMS

25
TECHNOLOGY BUSINESSES PER KM²

GREATER LONDON HAS THE HIGHEST DENSITY OF TECHNOLOGY BUSINESSES **IN EUROPE**
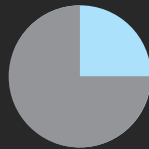
LONDON HAS **25%** OF ALL THE TECHNOLOGY JOBS IN BRITAIN

LONDON HAS OVER **100,000** INTERNATIONAL STUDENTS, OVER A QUARTER OF ALL STUDENTS IN THE CAPITAL

78% LONDON ADULTS OWN A SMARTPHONE

90% OF LONDONERS USE THE INTERNET

OVER **460** TRANSPORT APPS HAVE ALREADY BEEN CREATED USING OPEN DATA

DATASTORE RECEIVES OVER **40,000** VISITS A MONTH

HERE EAST, THE NEW DIGITAL HUB DUE TO FULLY OPEN IN 2018 ON THE OLYMPIC SITE WILL
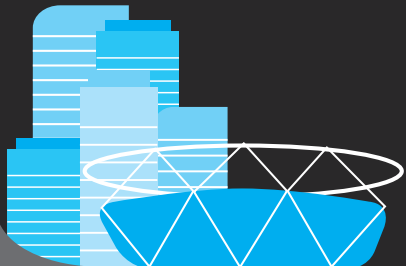
CREATE **7,500** JOBS

£460 million IN GDP TO THE UK ECONOMY

WI-FI IN 250 TUBE STATIONS

£1.75 million FREE WI-FI FOR OVER 80 PUBLIC BUILDINGS & LIBRARIES
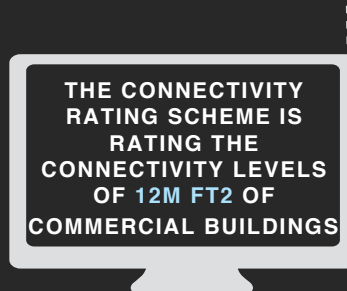
THE CONNECTIVITY RATING SCHEME IS RATING THE CONNECTIVITY LEVELS OF **12M FT2** OF COMMERCIAL BUILDINGS

MAYOR OF LONDON HAS SECURED **£5 million** FOR A DIGITAL TALENT PROGRAMME TO HELP YOUNG PEOPLE GET TECH JOBS

London is a leader in digital technology

INTRODUCTION

1 Smart London

London is and works hard to remain a smart city. Worth £19bn, London's tech market is the largest in Europe. There are 40,000 digital businesses and 200,000 employees in London's technology sector[1]. As the biggest city in Europe, London can amplify solutions built to meet its own challenges using its unrivalled communication, transport, and business connections.

Smart London is about helping the capital function better and making Londoners and businesses part of world-leading ideas. Londoners generate data that helps the city manage its transport, social, economic and environmental systems. London's innovators create the technologies to meet the real-world challenges we face.

This is about solving real-world problems. Technology is and will continue to become more central to solving London's challenges, whether adapting to population growth, maintaining our competitiveness or empowering our citizens. There are clear benefits to our 'smart' policies and programmes for Londoners and businesses. We are pushing 'smart' further in new ways, such as our city data strategy and sharing expertise through our European 'Sharing Cities' project.

The Smart London Board includes leading academics, businesses and entrepreneurs. They advise the Mayor on how digital technology can help make London an even better place in which to live, work and invest. They also work to promote the uptake of 'smart' in London and to engage Londoners on these issues.

[1] Oxford Economics commissioned by London & Partners, June 2015

2 Our progress

The Mayor's Smart London Plan was published in December 2013. It outlined how the Mayor planned to use the creative power of data and technology to serve London and improve Londoners' lives. We said then that we would update Londoners and businesses on our progress and plans in 2016. The Smart London Plan had seven aims:

Aims	Our progress
To put Londoners at the core,	We are experimenting with digital tools - from co-design programmes to online citizen engagement in policy development. One example is Talk London's focus groups. These helped shape new campaigns, such as our new micro-volunteering programme, and fed back on strategy work, such as that of the London Health Commission (LHC) - directly influencing strategy and delivery. We're also increasing Londoners' digital skills. We secured £5m from the Government's Local Growth Fund for our Digital Skills Programme called 'Digital Talent'. The number of Londoners using digital technologies to engage with City Hall is increasing. We want it to grow even faster in the future.
With access to open data,	We are harnessing data to solve London's challenges through the Datastore and Data for London, our City Data Strategy. We are building data products and platforms to show the tech sector what is possible and to test growth scenarios for London and its infrastructure.
Leveraging London's research, technology, and creative talent,	We have supported smart, connected businesses through our Export Programme and International Business Programme, Super Connected Cities scheme, connectivity toolkit, and connectivity rating scheme. We want to improve our support for London's SME tech community as the number of employees in the technology sector moves past 200,000.

Aims	Our progress
Brought together through networks,	The Smart London District and Infrastructure Innovation Networks are identifying and bringing together London's tech talent to work on London's challenges. We will be supporting new networks in 2016. City Hall is also leading an EU-funded network, 'Sharing Cities' with the Royal Borough of Greenwich and the cities of Lisbon and Milan, Bordeaux, Burgas and Warsaw. It aims to show how innovative uses of technology – for example, using the River Thames to heat homes, testing electric bikes and trialling state-of-the-art smart parking bays - can improve the lives of residents.
To enable London to adapt and grow,	We're promoting new and smarter heating, electricity, waste and water networks that use resources efficiently and do more with less investment. The Infrastructure Mapping Application (IMA LDN) and our work in speeding up London's transition to a circular economy are other ways we're helping the city to grow and adapt.
And City Hall to better serve Londoners' needs,	The Smart London Borough Partnership is increasing data sharing between the boroughs. It identifies opportunities to roll solutions out at scale. We are inviting new ideas from London's tech community. For example, in transport, over 100 projects are now being run through TfL's innovation portal.
Offering a 'smarter' experience for all.	We're working hard to improve the lives of Londoners through digital technology. We are demonstrating this through projects in sustainability and transport in Queen Elizabeth Olympic Park as part of the Smart London District Innovation Networks. London's connectivity is improving, but we still need faster networks to capitalise on the digital talents of Londoners and businesses.

Smart London is delivered through three overarching workstreams:

1. Engaging Londoners – using smart technology to enhance the range of ways that we involve and empower Londoners and businesses.

2. Enabling good growth – harnessing data and digital technology to meet the growth challenges facing London's infrastructure, environment, and transport systems.

3. Working with businesses – leveraging opportunities for innovation and business growth.

3 The opportunity

In order to promote the benefits of 'smart' in London we must better understand the size of potential investment in the 'smart' sector in London. To do this, City Hall commissioned Arup to estimate London's slice of the global smart cities market. They concluded that the market in smart city technologies and associated products and services in 2020 will be worth US$13.4bn (£8.9bn), or roughly one per cent of the worldwide market[2].

The market in 'smart cities' is extremely diverse and difficult to categorise. However, over half of London's contribution, or roughly US$7bn (£4.6bn), could be attributed to the smart energy, transport and mobility, healthcare and environmental infrastructure (water and waste) sectors combined (see Figures 1 and 2). Arup reported to City Hall on market opportunities to address London's challenges with digital solutions in these four sectors. The report identified other markets for future research that includes the areas of governance, security, and buildings. The figures below show the potential size of the market in London by 2020 based on the city's strengths, population growth and economic output.

[2] Frost & Sullivan, Strategic Opportunity analysis of the global smart city market, Aug-13
TechNavio, Global Smart Cities Market 2015-2019, Feb-15
Marketsandmarkets, Smart Cities Market (Smart Home, Building Automation, Energy Management, Industrial Automation, Smart Healthcare, Smart Education, Smart Water, Smart Transportation, Smart Security), Services) – Worldwide Market Forecasts and Analysis (2014 – 2019), May-12
Transparency market research, Global Smart Cities Market - Industry Analysis, Size, Share, Growth, Trends and Forecast, 2013 – 2019, May-14
Mordor Intelligence LLP, Global Smart Cities Market - Growth, Trends and Forecasts (2014-2020), Sep-15 BIS & Arup, The smart city market: opportunities for the UK, Oct-13

Figure 1 London 2020 Smart City Market Size Potential
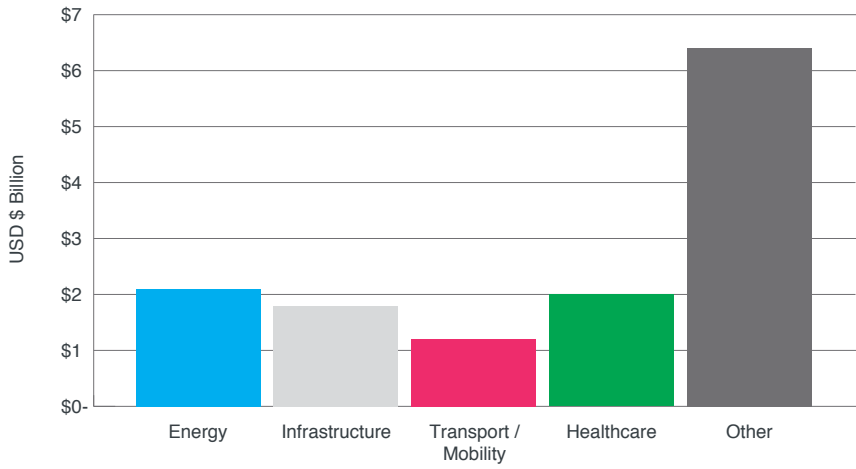
Figure 2 London 2020 Smart City Market
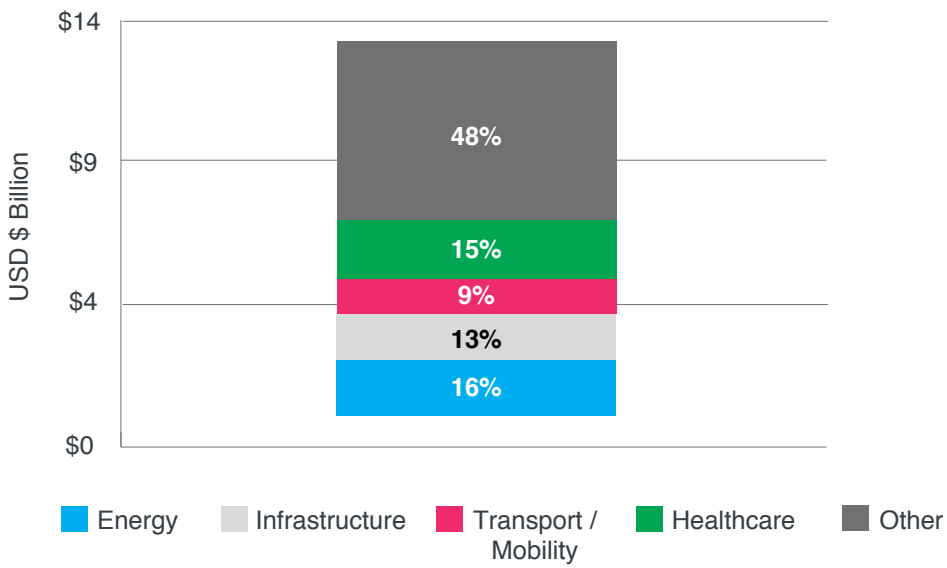
These figures show the scale of the opportunity open to inward investors, venture capitalists and entrepreneurs.

ENGAGING OUR CITIZENS

Londoners generate the data that helps the city manage its transport, social, economic and environmental systems. Digital technology presents opportunities for the capital to use this data to function better, and for Londoners to help shape and be a part of these solutions.

1 What we said we would do and what we did

We said we would harness new technology and data to increase digital engagement and tackle the gaps in digital skills to improve the experiences of Londoners, businesses and visitors.

1.1 Increasing digital engagement

We said we would:

- Ask Londoners what they see as the challenges they would like addressed, and how they can be part of the solution, using London's dashboard and other digital tools to engage residents. **We've recruited a number of focus groups through our online research community, Talk London. Talk London members have talked to us in depth about City Hall communications and how we can improve them. The feedback from these focus groups has already helped shape marketing campaigns, like Team London's digitally enabled volunteering programme. We also run a 'Talking Points' survey on City Hall's hot topics. This gets over 500 detailed responses every two months on issues from infrastructure investment to broadband provision. New ideas for shaping solutions to London challenges will be emerging during 2016/17 from the Smart Citizen co-design programme currently being developed.**

- Increase the number of Londoners who use digital technology to engage in London's policy making. **In November 2013, some 38 per cent of Londoners surveyed did this, increasing to 45 per cent in January 2015 and 52 per cent in January 2016.**

- Host hackathons to involve Londoners in solving the city's growth challenges. **On 18 June 2015 – Live Earth Day – Climathon, a 24-hour hackathon-style climate change event organised by Climate-KIC, was held in London and major cities around the world. Climathon was focused on supporting citizens to take direct climate action by working on fresh solutions to local challenges. In December 2015, we featured the Climathon results at the UN's COP21 climate change conference.**

  We helped our citizen-hackers understand our challenges in the energy and waste sectors. We asked how we can reduce London's emissions through shifting 20 per cent of peak energy demand, and increasing distributed solar power, by 2020; and reducing waste by putting it in a circular economy not a landfill.

  London's Datastore provided a data-rich access point for the hackers. In time for Climathon we released electricity data from 5,567 smart meters from London households in network operator UK Power Networks' Low Carbon London project.

- Engage one thousand people per borough through City Hall's online research community by 2016. **We have run two Annual London Surveys on the Talk London platform. This has increased our membership to 15,500 people on Talk London. Based on the rise in members in 2015, we predict that we will add around 5,000 members per year in the near future. With this increase, we will be able to continue to improve our hyper-local research activity for London's policymakers.**

- Increase the number of Londoners who use digital technology to access information about the city. **In November 2013, some 80 per cent of Londoners surveyed did this. By January 2015, this had increased to 83 per cent, and 89 per cent a year later in January 2016.**

- Double the number of monthly unique users on the Datastore and dashboard by 2018. **In October 2013, some 28,309 users visited the London Datastore and 1,228 visited our dashboard. The dashboard has now become part of the Datastore. In September 2015, the Datastore had 45,000 unique visitors per month. That is an 86 per cent increase in just two years.**

- Establish a Smart London Platform to create a feedback mechanism. **We built this platform for the relaunched Smart London section of london.gov.uk in November 2015. In 2016 we will build on this to provide opportunities for greater interaction with Londoners.**

- Invest in free Wifi in London's art galleries and museums. **The Public Building Wifi Scheme was part of London's Super Connected Cities programme in 2014-15. It made £1.75m available to fund free public Wifi installation or upgrades in over 80 public buildings – including the British Museum and Tate Modern.**

- Increase the number of Londoners who think the use of digital technology has improved London as a city to live in. **In November 2013, some 68 per cent of Londoners surveyed thought this. This had fallen to 66 per cent in January 2015, but had leapt to 77 per cent by January 2016.**

CASE STUDY: TALK LONDON
Wendy Lewis, Online Engagement Manager, Greater London Authority

The Talk London community brings Londoners into the policy making process. Talk London hosts online discussions, polls, surveys and online focus groups - discussing a wide range of topics from improving standards in the private rented sector to cyclist safety around HGVs (heavy goods vehicles).

Through the community, Londoners are taking part in policy conversations to generate new ideas. We can also consult Londoners on our ideas to make sure that policies are responsive, effective and resonate with communities. When people register to join the community we collect key demographic data and ask people about their interests. This makes it possible to target certain groups of people to get into conversations that interest them and ensure we are engaging a broad range of Londoners.

In conjunction with other efforts such as the London Datastore, which makes public over 500 sets of London data, we are leading the drive to harness technology and data to increase transparency and citizen engagement.

We've now carried out the annual London Survey through Talk London twice. Previously this had been commissioned out, and was slow and costly. The survey covers everything from housing, transport and policing to culture, the environment and more. The results will help to support the development of the Economic Evidence Base for London. This, in turn, will provide background support to three of the Mayor's main Strategies (London Plan, Economic Development Strategy and Transport Strategy).

We've also had a real impact in our work on health. Throughout 2014, the London Health Commission looked at how health and healthcare in London can be improved. Talk London members made their views known through discussions, polls and surveys on the community. This feedback directly influenced what was sent to the Mayor in their final recommendations document.

We've also recruited a number of focus groups through Talk London. Our members have talked to us in depth about City Hall communications and how we can improve them. The feedback from these focus groups has already helped shape marketing campaigns like the latest for Team London's volunteering programme – and we run a bi-monthly 'Talking Points' survey with our growing membership. This flags up City Hall's hot topics and gets a strong five per cent plus response rate each time.

**VISITOR EXPERIENCE –
THE SMART PARK**
**Jim Wood, Director of IT
& Information Services,
London Legacy Development
Corporation (LLDC)**

A new heart for east London, Queen Elizabeth Olympic Park is the city's smartest and most sustainable park. The Park embeds five world class sporting venues, 10,000 new homes, a new international quarter for business, a world class cultural and education quarter and a new media and digital hub into its 560 acres, creating an oasis in the middle of one of the world's most diverse and densely populated cities.

Our vision for a Smart Park means transforming the way visitors and residents use the Park, a drive which brings with it immense sustainability benefits. Wherever, and whoever you are in the Park, you are wifi connected. Free wifi is provided to all visitors to the Park. Superfast Broadband has been installed

and the Queen Elizabeth Olympic Park app will help you keep up with the latest Park news and events.

Working with Smart London Innovation Network partners, the LLDC will be bringing forward a range of trials to test new ways to use technology to manage an urban district, focussing on the challenges of smarter crowd management, environmental sensing, community building and user engagement.
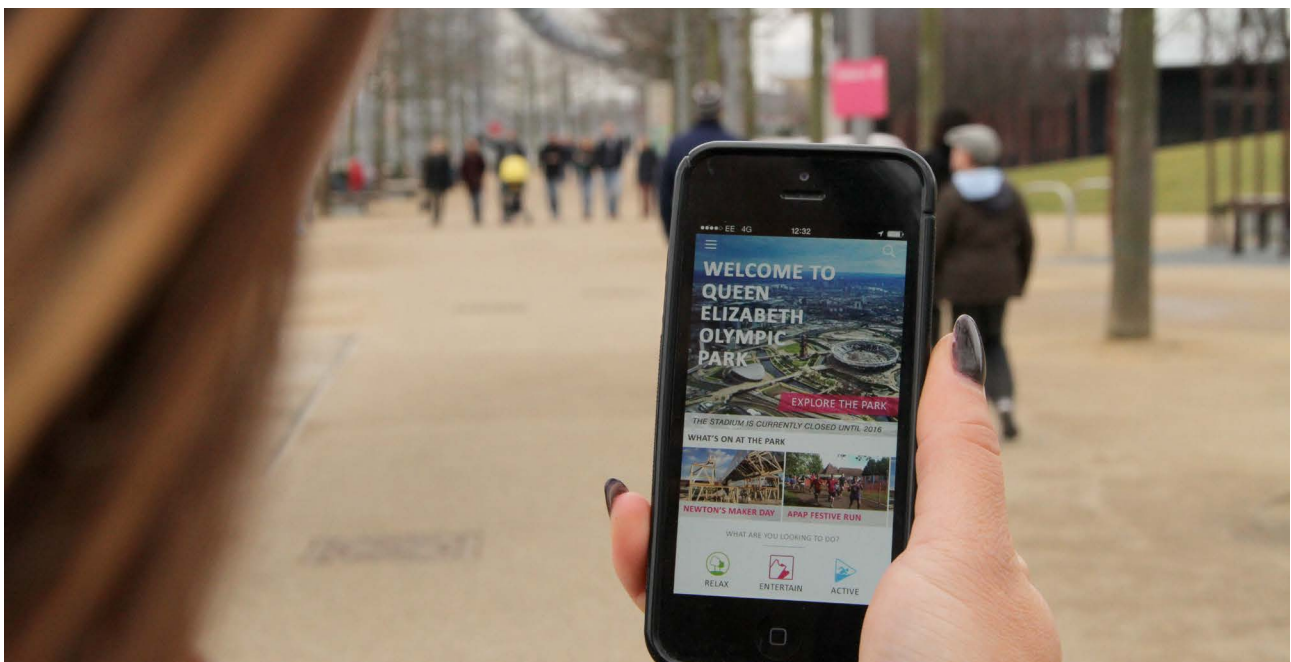
The London Legacy Development Corporation's Smart Park app

CASE STUDY:
WAYFINDR @EUSTON
Kuldeep Gharatya, Head of Technical Strategy, London Underground (LU) Technology & Innovation Team

London Underground's Technology and Innovation Team have carried out a number of industry first trials on how intelligent infrastructure could interact with our visually impaired customers. This shows how Smart Cities concepts can start to solve the accessibility challenges faced by some of our customers.

In January 2016 at Euston Underground station, visually impaired participants were guided from the station entrance to the platform edge via audio directions from a prototype smartphone app. This app interacted with beacons installed at wayfinding points throughout the station. This helped them reach their underground destination.

The trials looked at whether this system could work reliably across the Tube network. They also looked to test and refine Wayfindr's standards for audio navigation via a 'permanent' demonstrator which engineers can alter in response to user's experiences. We also considered potential impacts upon the business of installing and maintain these beacons. By identifying opportunities to use them for other purposes, we strengthened the business case.

This challenge of providing indoor and underground navigation is a very topical issue that several big technology companies are trying to solve.

A visually impaired person testing the Wayfindr app
©Transport for London

CASE STUDY:
LONDON AS A LIVING LAB

Duncan Wilson, Intel Director at the Intel Collaborative Research Institute for Sustainable Connected Cities

How can we best engage a crowd to give their opinions and feedback in-situ?

The London Living Labs is an end-to-end Internet of Things (IoT) infrastructure that enables experiments to be carried out in the city. It was set up by Intel, UCL, Imperial College and the Future Cities Catapult, with support from local stakeholders in London's schools, parks and city neighbourhoods. It is shaped by an ethnographic research process. This helps us rethink how we monitor, measure and manage cities, from citizen services to collecting the census.

Gauging public opinion and gathering feedback helps to improve the experience offered at public events, improve products or customer services, or target audiences for engagement, but it can be hard to get people to give feedback. Handing out questionnaires at events can give in-situ feedback. However as it requires interrupting people in their activities it often has low response levels. Emails or web surveys after the event can reach a large audience, but response rates are typically low and feedback is taken out of context. VoxBox aims to turn the task of filling out a questionnaire at an event into a pleasurable and engaging feedback experience, whether as an individual or as a group.
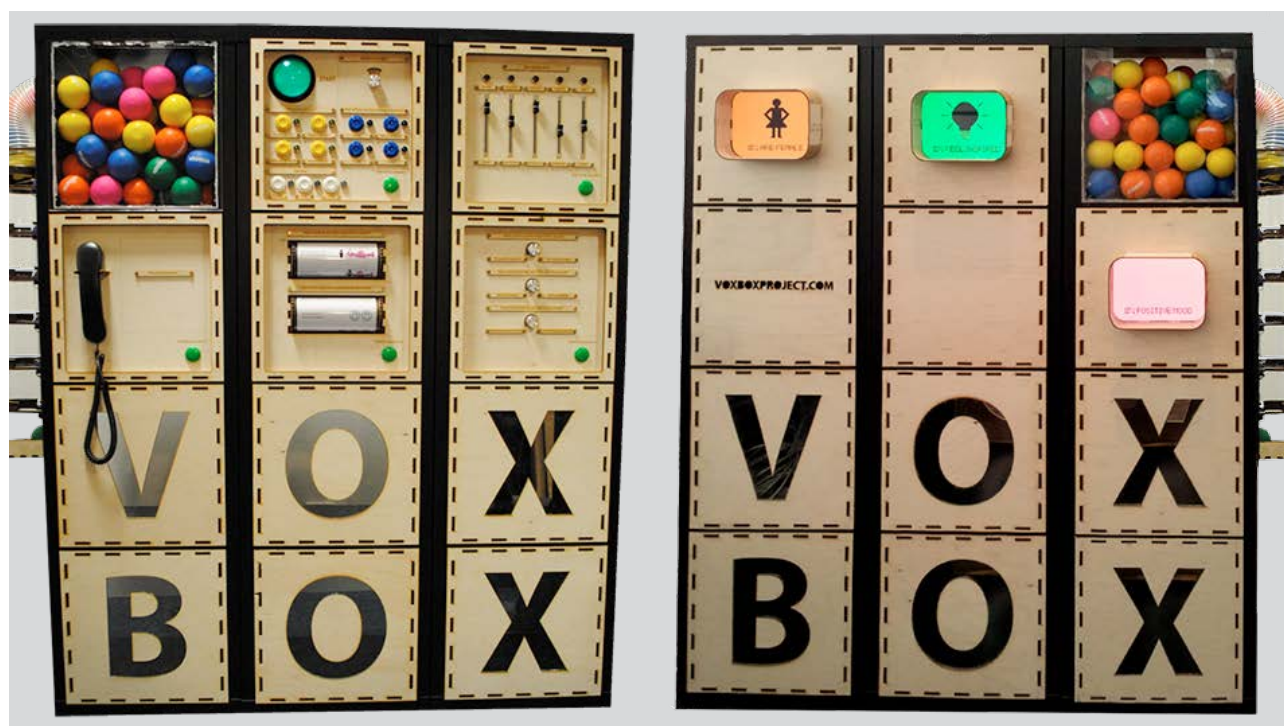
Voxbox, the visual questionnaire machine ©Intel

VoxBox is a physical questionnaire machine. It means people attending events can share their views using a range of sliders, dials and buttons. They can then see how their views compare to others at the event by looking at real-time data visualisations on the flip side of the device. VoxBox was designed by considering traditional questionnaire structure and limitations. It employs deliberate strategies to: encourage participation and completion. It shows progress throughout the survey, groups similar questions and gathers answers to open and closed questions. Finally, it connects answering and seeing results more closely. The system is modular and consists of five question modules around demographics, current mood, crowd information and event feedback.

The system has been used in several locations from fan parks at the Tour De France to Somerset House to gather census data. Looking forward, we want to know how this approach embeds tangible feedback into the urban realm.

1.2 Digital skills

We said that would:

- Tackle skills gaps so that everyone can take part. **We secured £5m from the Government's Local Growth Fund for the Digital Skills Programme: 'Digital Talent' to run in 2016/17 and 2017/18. It is designed to increase and improve the provision of industry-relevant digital training and education in London to help young people get jobs. The Digital Talent Programme will:**

  1. **Convene a Digital Talent taskforce of corporate employers and SMEs to inform the development and the creation of 'digital labs' in further education colleges**

  2. **Create a Digital Talent Management programme to give young people aged 14-24 years the skills employers are looking for, creating a pipeline of talent**

  3. **Provide interventions and work experience for young people who are in Higher Education to supplement their skills**

  4. **Open a kit fund to set up five digital centres of excellence across London, providing access to the latest equipment**

  5. **Give teachers opportunities to gain awareness of jobs in the sector via Computing CPD networks and building relationships with industry**

  6. **Campaign to inspire young people, particularly from disadvantaged backgrounds and young women, to boost their digital skills and find jobs in the industry**

- Deliver a London-wide digital inclusion strategy by 2014. **We published 'A digital inclusion strategy for London' in January 2015. Over 90 per cent of Londoners over 16 had used the internet in 2014. That number had risen to 91.3 per cent by the first quarter of 2015.**

- Double the number of technology apprenticeships by 2016. **We expect to double the number of 2012/13 apprenticeship starts in 2015/16. There were 1,210 IT apprentice starts in the academic year 2012/13. This increased to 1,560 starts in 2014/15 and 1,330 starts in the year up to April in 2014/15.**

- Deliver an online marketplace for flexible volunteering and working to help make young people (16-24) more employable. **Team London, our volunteering programme, partnered with charity Do-it to launch the capital's first 'Speed Volunteering' service making it even easier to volunteer.**

  Speed volunteering roles are designed for people to give a little bit of time on a one-off basis to make a real difference. By removing the barriers to volunteering, it is bringing together Londoners and volunteering networks to make sure London makes the most of its talented people.

The new speed volunteering app allows volunteers to find opportunities, share information with friends and record the impact of their volunteering.

Team London is also recruiting 'Enterprise advisers' who will work with teachers to develop their careers offer and bring speakers from tech start-ups into schools. They also want businesses to release volunteer advisors to become school governors.

© Mayor's Fund for London

- Use London Schools Excellence Funding to increase uptake of computer science in schools. **The London Schools Excellence Fund invested £1.2m in the creation of four computer science projects in 2014/15 across 438 schools with 1,600 teachers. The projects covered primary and secondary school students from Key Stage 2 (Year 5) to Key Stage 5 (A-Level)**

- Establish 'Tech City Stars' to equip local young people to take on digital apprenticeships as a route into paid work. **Through the Mayor's Fund for London we've supported Tech Up Nation. This £2m pilot programme gives young people in the Old Street area a digital apprenticeship and City & Guilds NVQ bespoke to the industry. As of March 2016, the project has helped 375 young people in employability training. Of these, 197 have received further pre-apprenticeship training, and 132 had completed training.**
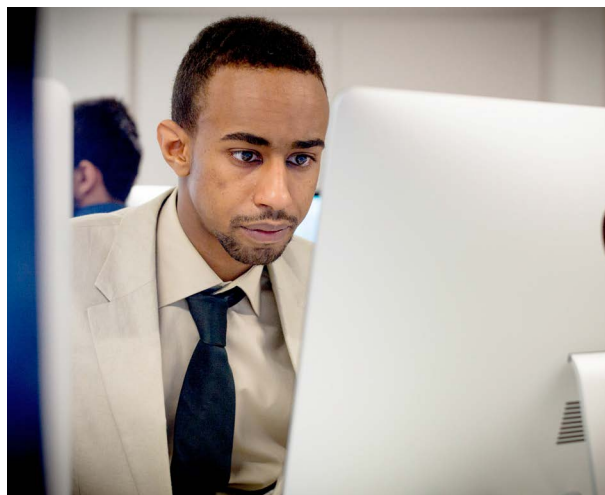
CASE STUDY: CIVIC CROWDFUNDING
James Parkinson, Senior Project Officer, Regeneration, Greater London Authority

The Regeneration Team's Civic Crowdfunding pilot programme is looking at the potential for the Mayor to pledge to citizen-led civic crowdfunding projects as 'one of the crowd'. This will mean working in new and more direct ways with Londoners and placing more power in local communities to shape projects that matter to them.

Local groups like town teams, business improvement districts and resident and trader associations, were asked to pitch ideas to improve their local High Streets via the crowdfunding website Spacehive.

Groups could propose an idea and then build local awareness and enthusiasm for it using social media, community events or local press. The aim was to try to reach the funding target they required to make it happen. Crowdfunding works by enabling large numbers of people to 'pledge' towards a project and only be called upon for payment, should it reach its target. If enough people like an idea and pledge a small amount of money to see it happen, a lot of capital is quickly secured.

Over two rounds in 2015, the Mayor pledged, as one of the 'crowd', £600,000 between 37 projects to make a real difference to local communities across London. In round two alone, over 2,000 Londoners backed 15 of the projects with over £350,000 of pledges during their crowdfunding campaigns.

So far, we've backed a diverse range of projects. These include a community 'makerspace' in Herne Hill, where local people can access specialist equipment and training to support small business incubation; an empty shop turned into a thriving community centre where residents developed a neighbourhood plan; and a feasibility study for a new public park in Peckham which will turn disused railway sidings into a new 1km stretch of green space.

In 2016, the Regeneration team will further refine the pilot with two rounds of 'pledges' to local projects, linked to the London Regeneration Fund. Alongside this, the team has prepared an outline proposal looking at how the Mayor could crowdfund projects at scale, across City Hall's teams and priorities. By leading a cross-organisational working group, we will develop this proposal for a Mayor-led civic crowdfunding hub for Londoners before the incoming administration.

© South London Makerspace

CASE STUDY: LONDON RESILIENCE PARTNERSHIP
Matt Hogan, London Resilience Officer

The openness and accessibility of data from public agencies like TfL, the Met Office, and the Environment Agency is allowing fresh third party uses of data. Examples include:

- GaugeMap which offers real-time information on all EA flood gauges

- WOW – the Met Office crowdsourcing of amateur weather data to complement official readings, and

- City Dashboard by UCL which provides a real-time 'state of London'. This is useful for identifying trends and connected issues in the event of an emergency.

In February 2015, 'Talk Resilience' was held at City Hall with people from across the community and voluntary sector. This was a useful platform to exchange views on resilience and emergency response.

In September 2015, @LDN_prepared took part in the international 30Days30Ways campaign to raise the profile of being prepared for emergencies through simple actions.

In October 2015 the London Resilience Forum supported the flu immunisation activity of Public Health England's flu immunisation programme. Some 35 forum members were vaccinated as part of a campaign to increase uptake in target groups.

The Department for Communities and Local Government has funded the London Fire Brigade to develop an information sharing platform for the London Resilience Partnership to use in an emergency. London Resilience is actively working towards a range of engagement events to develop this with Londoners and the Partnership.

©The Design and Technology Association

2 Future opportunities

The Smart London board have made the following recommendations for
the next Mayor.

2.1 Increasing digital engagement

The Mayor should:

- Work with the London Resilience Partnership to find new ways to communicate with the public during and after emergencies - for example through testing network theory, analysing social media, picture and video communication. This will benefit both emergency planning and preparation. It can also create new ways to communicate with and get feedback from residents and businesses outside of states of emergency.

- Use the new Talk London site launched in January 2016 to engage more Londoners digitally. improvements include a 'Your Impact' block on the homepage which will be a permanent fixture letting Londoners know how their comments and suggestions were used.

- Use technology more for impact assessments of policies and programmes. Recent advances, from dashboards to harvesting social media, are powerful ways to gather data from Londoners and businesses about whether policies and programmes are working. Similar solutions have been built for clients in the retail sector, including shopping centres that target the digital conversations in specific areas of a city. If these solutions are retooled, they have the potential to increase digital engagement between government and citizens.

- Increase citizen engagement in the product development and application of smart solutions by integrating more democratic processes into policy development and application.

- London's government should explore the power of the crowd to source, fund, and finance ideas to solve the city's infrastructure challenges and test new ways of designing it before it's needed. The London Infrastructure Mapping Application should help stimulate this new approach. This could lead to scalable smart solutions that are currently untested. Potentially, this could unlock funding sources and financing mechanisms for London's government, residents, and businesses.

Londoners and Businesses should:

- The tech community must increase its engagement with Londoners to ensure innovation meets demand. With City Hall's support, the tech community should engage citizens and enable more co-design between developers and citizen and business groups. This will ensure smart innovation to meet user need. They should also partner with digital skills providers to share the lessons of co-design from public sector-funded projects to the tech community.

- Londoners should take up opportunities to engage with City Hall and local boroughs to raise awareness of what challenges they would like smart technology solutions applied to, and how.

- Londoners should become more involved with initiatives to source new ideas via crowdsourcing. Recent examples of digital crowdsourcing tools include Spacehive through the Mayor's High Street Fund, Stickyworld at Eltham High Street in the Royal Borough of Greenwich, and Commonplace in the Waltham Forest mini-Holland programme, sponsored by the Mayor.

2.2 Digital skills

For the Mayor:

- Ensure all Londoners are 'digitally included' and can benefit from schemes such as GO-ON UK's work in Croydon and Lewisham. GO-ON, the UK's digital skills charity, highlights and promotes the opportunities available online, and how the internet can benefit people.

- Explore how the Mayor and London boroughs can work together to improve data literacy and data protection for citizens, businesses and the public sector.

- Run a 'Digital Careers Roadshow' in 2016 to inspire young Londoners aged 15-25 to consider careers in the digital and tech industry and engage with employers.

- Promote gender diversity in tech and ask businesses to publish data on their diversity record.

For Londoners and Businesses

• Tech firms should scale-up existing corporate led efforts to address digital exclusion, such as BT and EE's Digital Champions programme.

• Use Tech.London to provide a clear, well explained, source of information and advice on the range of pathways to a digital career, and the financial help available.

• Redesign technology apprenticeships to be fit for the purposes of the digital sector and support SMEs to collaborate on building sustainable, shared apprenticeship programmes.

• Industry should carry out a full assessment of all industries for digital technology. The Board should work with stakeholders like London First, Tech London Advocates and the Chamber of Commerce to promote the digital skills that the technology sector needs.

Codesigning creates new options to consider

LONDON'S GROWTH

POPULATION PROJECTION

2036

10.0 - 10.5 MILLION

2023

9.3 - 9.5 MILLION

2011 census

8.2 MILLION
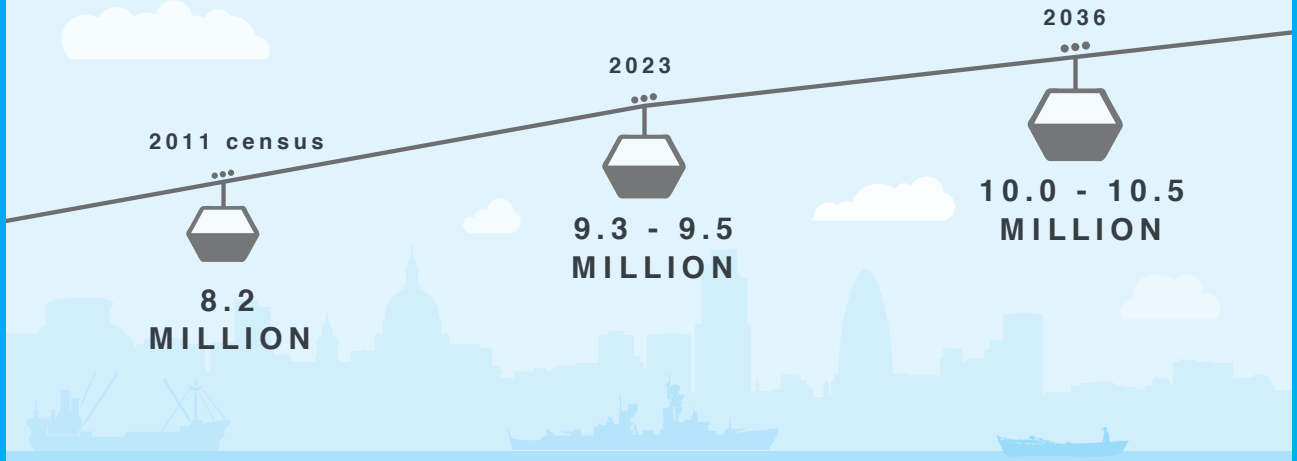
LONDON WILL NEED **750,000** MORE JOBS BY 2036 THAN IN 2011

PUBLIC TRANSPORT WILL NEED TO ACCOMMODATE **5,000,000** MORE TRIPS PER DAY IN 2031 THAN IN 2011
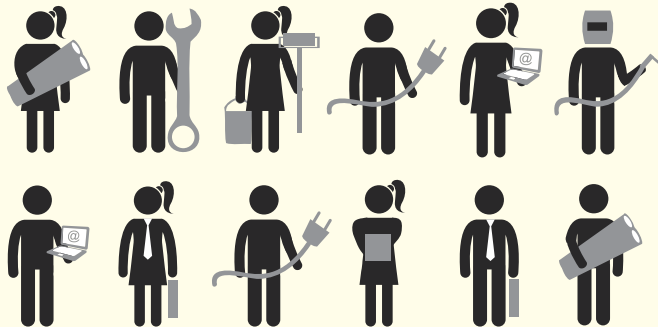
49,000 MORE HOMES PER YEAR FOR THE FORESEEABLE FUTURE

CONGESTION ON LONDON'S ROADS COSTS THE ECONOMY OF £4 BILLION A YEAR

London's growth challenge

ENABLING GOOD GROWTH[3]

The population of London is predicted to increase from 8.6 million today to over 10 million in 2036.[4] London is showing the world how data and technology solutions can support a city's growth. The Datastore streams out free and open-source city performance data. This means that developers both inside and outside government can use the data to make new software and platforms to help the city work better.

London's water, waste, and energy systems need careful management, from getting data from smart meters to programmes to peak consumption and leakage. Investment in London's infrastructure needs efficient planning, delivery and coordination. TfL is investing heavily in smart solutions from predicting crowd behaviours to underground navigation.

[3] Good growth responds to the needs of Londoners and businesses - from creating the conditions that will foster growth and regeneration, such as a high quality public realm, to investing in supportive infrastructure to accelerate development. Good growth is integrated, innovative, inclusive, well located, targeted and high quality. To learn more, read the Mayor's Design Advisory Group reports on the Good Growth Agenda launched in February 2016.

[4] London Datastore, data.london.gov.uk

1 What we said we would do and what we did

We said that London would combine emerging technologies, its creativity and the vast amount of data generated daily to make London a leading 'smart city'. We are doing this through our own work and new collaborations between Londoners, government, industry and academia.

1.1 Harnessing data to solve city challenges

We said we would:

- Establish a Smart London Borough Partnership to identify and showcase how open data can save London boroughs money, and deliver better services. **We founded the Partnership in July 2014 to understand Londoners' problems and challenges, and identify data needs and gaps that could help solve these. As of January 2016, it has met five times to raise aspirations for public services.**

  London Councils and the GLA have successfully bid to be in the Cabinet Office's Data Science Accelerator programme to encourage data sharing and cross-border data analytics.

- Create and publicise compelling evidence-based stories to demonstrate the power of open data for Londoners and businesses. **The Datastore blog includes over 50 stories about how it is a centre for data-led innovation in London. We are building a culture of a guaranteed supply of city data, and have updated over 300 of our 612 datasets at least once in the**

last year. Our strategy of opening up proprietary data in machine readable form is helping third parties to develop products or analysis that benefit stakeholders and the wider digital economy. For example, the open data section of TfL's website has more than 5,000 developers registered to receive data sets.

- Evolve the London Datastore into a global exemplar platform by the end of 2016 that will aggregate disparate data sets and connect sensor networks across London, working with world cities. **The Datastore won the 2015 Open Data Institute's Open Data Publisher Award. The Datastore includes work being done in other global cities, including data on waste in New York, water in Toronto, and energy in Seattle. We're contributing to the development of data platforms for cities in the European Commission's European Innovation Partnership.**

  We're continuing to develop innovative, data-led work around the Datastore through:

  - **A data sharing and exploitation initiative between London and Singapore called 'Data City: Data Nation', which is led by the UK's Digital Catapult, we have the opportunity to run a series of city data challenges**

  - **Project Witan (featured in a case study in this document), our platform for sharing city models to test growth scenarios for London from 2016**

- Developing a secure sharing environment via the Datastore for sharing private data among trusted and vetted officers, researchers, and suppliers from 2016

- A platform for data generated by sensor networks, or the Internet of Things technology from 2018

- Find new ways to link how London performs on different indicators with what City Hall, or London boroughs are doing about it. **We're starting by building our own data products to show others what's possible. Examples include the Infrastructure Mapping Application, London Schools Atlas, and MyLondon, an interactive personalised dashboard for home movers. These products will catalyse ideas on how companies can identify the datasets they need and what City Hall can make available.**

The London Landscape is a joint project between the GLA and the Mayor's Office for Policing and Crime (MOPAC). It aims to map and make available over 150 London crime, demographic and socioeconomic datasets in an interactive easy-to-use online format. It has also made interactive data dashboards that allow the public to access the latest crime, policing and criminal justice data.

- Conduct research to monetise the efficiencies that can be generated from data sharing, and how service delivery can be improved. **We did this research as part of our City Data Strategy which we published in March 2016. This strategy sets out city government's role in data publishing, the identification of needs and data governance. It also recognises the needs of the data value chain and of the technology sector.**

CASE STUDY:
LONDON DATASTORE

Andrew Collinge, Assistant Director, Intelligence, Greater London Authority

In 2014, with the help of Datapress Open Data Publishing, we relaunched the London Datastore. We have been true to our intention to be a lot more proactive around the core activity of data publishing. We've worked hard to publish – either from within or through other contributors – almost a blog a week. We're undoubtedly better at understanding and illustrating how data can be used to meet city challenges, and communicating this to our 45,000 unique visitors per month.

Our emphasis now is very much on developing 'city data', as an extension of open data. This switch is part of our move towards being more deterministic in identifying a city issue or challenge and then establishing the data we need to

tackle it. Our job is then to establish a sensible means of doing so, if that data comes from an organisation with a different set of considerations around the sharing of data (for example, competition issues).

Our Low Carbon London data release was a great success. The big data, at over a million lines, was sourced from a new city data partner, UK Power Networks. The Environment Team at the GLA used the data in a Climathon event designed to help us deal with London's, and other European cities', climate challenges.

Most recently, we have launched a minimum viable product for our integrated city modelling platform and the Mayor has launched the Infrastructure Mapping Application. Both are important in bringing city data to the fore in policy discussions.

Some of the apps available in the London Datastore

CASE STUDY: TRANSPORT FOR LONDON'S OPEN DATA AND BIG DATA

Vernon Everitt, Managing Director, Customer Experience, Marketing and Communications, Transport for London

Developer use of TfL's unified API has grown to 6,000 developers and 460 smartphone apps

The Unified API is TfL's open data store for use by the developer community. We capture live and reference data from our operations and transform these data sources so they can be easily used by third parties. This enables us to develop new and innovative services for our customers. It also allows better use of the road and public transport networks. It's a hugely cost effective approach as a large community of developers can provide great tools and services without any direct investment from us. Forty per cent of Londoners now use mobile apps powered by our data in this way. We've already seen the impact of open data (6,000 developers, 460 apps, 200 API elements) and big data (automated refunds, re-planning bus network, better information) used to real practical effect. There is potential for more datasets to be made freely and openly available to further boost these efforts. To encourage more active use of our open data and trial a vast number of new data sources, we have sponsored several hackathons in 2015 where developers prototyped apps.

The Oyster card was one our first, and most visible, ways that we collected data on customer journeys and their experiences. By analysing public transport data we better understand transport users' expected – and unexpected - journey patterns across the transport network. We are interested in where people travel, what mode they choose, how frequently they travel and how reliable their journeys are. These insights can be used by transport operators to inform decisions on the planning of services. For example, TfL and academic researchers have used data visualisation to map passengers' travel routes during scheduled changes to services (like from sporting events), and unscheduled changes (like temporary station closures). These visualisations can be an additional tool for transport organisations to inform planning and operational decisions on services, and to explain the transport network more visually to passengers.

We are now collecting and analysing data on customer journeys via more than the Oyster card. The use of contactless payment cards (CPCs) on London's transport system continues to increase. In the weeks before Christmas, the average number of journeys made every day using CPCs reached a new peak at 1.07 million. Since the launch in September 2014, there have been more than 265 million journeys made using CPCs. The proportion of pay as you go journeys being made using CPCs continue to go up each week, reaching 26.6 per cent for Tube and rail journeys and 23 per cent for bus journeys. These numbers are increasing at between 0.2-0.4 per cent weekly.

CPCs can also be enabled on mobile phones and a number of such applications are now live in the market, including Apple Pay and mobile wallets run by Vodafone and EE. The launch of Apple Pay in the UK saw a sharp rise in the number of mobile transactions. Overall, in the second half of 2015 more than 3.2 million journeys were made using mobile devices. The share of mobile devices in overall contactless use has been growing and stood at approximately 3.5 per cent in December.

CASE STUDY: CITY DATA STRATEGY

Andrew Collinge, Assistant Director, Intelligence, Greater London Authority

We need a 'city data' approach, in which city government sets out in relation to city challenges and innovation opportunities the big data it wishes to see exploited. It is also the job of city government using policy, regulation and political pressure to ensure that other bodies presiding over large value tracts of data (for example utilities, developers, banks and housing associations) share it to allow for its exploitation. This is why we're producing Data for London, our city data strategy.

There is a growing sense that city government is selling itself short if it pursues an open data publishing strategy only. We are writing this strategy because data is a critical component in the city ecosystem, even sometimes described as a utility in its own right.

As city government, we think it is important to set out the case for: better, more harmonised data sharing across government (for instance the London boroughs); increasing the share of published data that comes from private sector sources - from utilities to telecoms companies to developers the secure, sharing of data to encourage the private sector to share data in a way that helps them to overcome concerns about competition issues and data security.

Importantly, the strategy will also set out how we will build on exercises like the London Infrastructure Mapping Application to exploit the true potential of the data. The aim is to provide tools and 'big data' analysis that can help us answer city challenges and meet opportunities for good economic and social growth. The applications built out of the datastore will benefit individuals, the public sector and the private sector.

We're also using the exercise to understand how London and its public services can benefit from trends such as the Internet of Things (again why harmonised and interoperable data matters), and how city government should take account of products and services like bitcoin and blockchain.

The six themes of London's City Data Strategy – see http://data.london.gov.uk/data-for-london/ for the themes in full

CASE STUDY: SIMULATING LONDON

Professor Andrew Hudson-Smith, The Bartlett Centre for Advanced Spatial Analysis, University College London
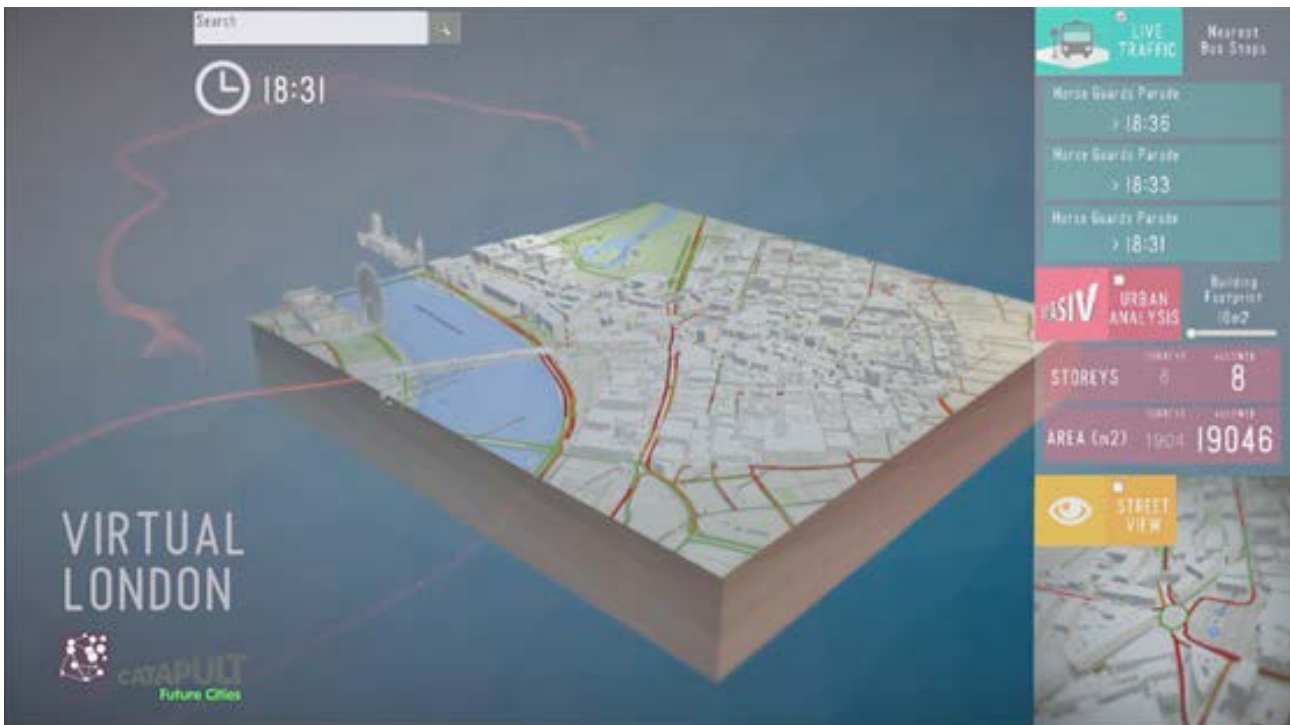
Simulating London. Courtesy UCL Bartlett Centre for Advanced Spatial Analysis

Core to Smart London is data. The London Datastore is a world-leading example of how data can be shared, distributed and used by companies of all sizes to benefit from the open data movement. The next step in the journey towards a Smarter London is joining up the vast amounts of data, simplifying its use and linking it to city-wide data visualisations. The Future Cities Catapult, EIT Digital, Ordnance Survey, London Legacy Development Corporation, Intel, and the Bartlett Centre for Advanced Spatial Analysis, UCL are working together on developing a public facing 3D London model and data system for Greater London. The model aims to provide a snapshot view of London both above and below ground, allowing datasets to be joined up, known as Linked Data, and visualised for the next level of city based applications.

The focus of the model, in its proof of concept stage, is to determine the application of linked data and above and below ground modelling at Queen Elizabeth Olympic Park. Developed as part of the Smart London Board, the 'Smart Park 'project, this 3D model will allow real-time visualisation of data. It will also move towards a simulated London with data projected into the future for the next phase of Smart City systems and data analytics. Such systems will help unlock the value of data across systems as diverse as future housing demand, transport analysis, urban planning, crowd safety, urban economics and beyond – toward a smart, simulated London.

CASE STUDY: BOROUGH DATA PARTNERSHIP

Andrew Collinge, Assistant Director, Intelligence, Greater London Authority

We founded the London Borough Data Partnership with some very simple reasons in mind. Whether it is school places or nitrogen dioxide in the atmosphere, more often than not, problems faced by public services do cross 'artificial' boundaries. The data at our disposal is often not as good as it could be. We're working to share, organise and structure it better with and between City Hall and the boroughs.

The analytical tools, big data approaches and range of potential collaborators mean we now have many better chances to deliver new insight and create new products that offer social, economic and environmental benefits to London's communities.

We're giving London boroughs a chance to listen to world experts in city data and join in streams of work designed to increase capacity in both data release and city analytics in local authorities. Our gatherings including non-profit bodies like the ODI and Future Cities Catapult, councils like Camden, Greenwich, Leeds, private sector companies like Mastodon C and Better Cities, and government organisations from the Cabinet Office to Innovate UK.

We believe that a more nuanced, coordinated and proactive approach to open data is possible across London. This will mean its full benefits can be realised and can be applied to maximum effect to help improve the city.

CASE STUDY: CAMDEN RESIDENTS' INDEX

Paula White, Analytics Client Architect, IBM

Camden built a 'residents' index'. The aim was to unite information from 16 council data sources to create a single, consistent view of residents and what council services they are using.

There are many use cases for joining up data in this way. The project is a key part of Camden's Digital Strategy. Having an accurate picture of its citizens and their households gives Camden a real basis for citizen -centric services. Aside from customer service innovation, it means Camden can ensure that taxpayers' money goes to the right individual and/or family. Camden believes the solution could really help to cut single person Council Tax discount fraud. Council housing sub-letting is a big problem in London.

This joined-up view of data is helping Camden ensure only legal tenants are in their properties. With the recent changes to the Electoral Roll in the UK, the project identified a significant number of potential voters. This has helped Camden have one of the most accurate Electoral Rolls in London. As a result, Camden has been able to withdraw school places from fraudulent applicants ensuring school places are allocated fairly.

Camden is a model for other London councils on how to join up their data. It has the potential to provide a matching service to other councils and has the trusted data foundation to enable multi agency working.

Bunhill Energy Centre, an Innovate UK-funded smart cities demonstrator project

1.2 Smarter Environment

We said we would:

- Promote the use of smart grid technologies. **Alongside the London Energy Plan, we're researching and promoting a self-sufficient London. Energy for London and CELSIUS (see p34 of the 2013 Smart London Plan) are two projects that encourage a move beyond smart grid technologies towards efficient urban energy system technologies. We're breaking down technical, social, financial and political barriers to:**

  - **Heat networks capable of storage and combined heat and power plant that balance energy demand and supply at a local distribution level.**

  - **Electricity demand-side management to balance local energy supply and demand and reduce the need for network reinforcement**

  - **Active network management to provide electricity-generating capacity when required to support the electricity distribution network**

- Promote the use of smart water metering to better manage consumption and leakage. T**hames Water will install 900,000 smart meters in London homes and new district level meters in the mains network over the next five years. These will help work out leakage, change behaviour and allow 'smart tariffs' and gamification to be introduced.**

- Make available the city's performance, consumption and environmental data as open data (energy, water, waste, pollution). **The Datastore now hosts data measuring Londoners' use of electricity gas, and waste including smart electricity meters, the state of London's water reserves, and the level of London's roadside air pollution. We're committed to working with all stakeholders who hold such data to make it available.**

- By 2020, stimulate smart grid services in London to limit growth in peak electricity demand and associated infrastructure costs, with 10,000MWh/annum of contracted supply and demand response. **We're working with Kiwi Power and Tempus Energy to allow citizens to play their part in avoiding the generation 'crunch', growth in peak electricity demand and help keep their energy bills down. Our Smart London Innovation Network districts are also looking for ways to collect and monitor a range of data which can be used to help better understand how districts work.**

- Work towards the Mayor's target for a reduction of greenhouse gas emissions – as of 2015 the target is for London to reach 60 per cent below 1990 by 2025. **Despite an ever increasing population and a cold winter demand, London's emissions in 2013/14 fell 11 per cent from their 1990 baseline and 20 per cent since their peak in 2000. With a population now at 8.6 million, London continued to reduce its per capita emissions by 28 per cent on 1990 levels and by 20 per cent on 2008 levels to 4.8 tonnes of CO_2 per capita in 2013. In the same period, London's gross value added (GVA) grew by 18 per cent. As more of the world's population moves to cities, London's example shows how CO_2 emissions can be decoupled from economic and population growth, and the opportunities of carbon-efficient city living globally.**

- Ensure London has the best air quality of any major world city by 2020. This will require a huge reduction in emissions from London's transport sector. **The Mayor has consulted on and confirmed his proposals to introduce the world's first Ultra Low Emission Zone (ULEZ), including new requirements for buses and taxis. This is expected to halve nitrogen oxide (NOx) road transport emissions in central London by 2020. Measurement sites show a downward trend in pollutants, including 7.5 per cent in oxides of nitrogen (NOx) from 2008 to 2013, 12.6 per cent in nitrogen dioxide (NO2), and 13.2 per cent in fine particulate matter (PM2.5).**

- Simulate the use of data and technology to help develop new markets for London's waste. **This will bring efficiencies and scale to the segregation and use of waste as a resource. We're working to make waste data available online to help inform both waste infrastructure investment opportunities. It will also help unlock and accelerate opportunities in the circular economy and help create jobs across London.**

As well as issuing policy guidance via the London Plan and the Mayor's Waste Strategy, we've developed the London Waste Map. We'll add this into the Infrastructure Mapping Application in the near future. The map covers strategic waste sites identified by local councils. It can overlay other land uses like our future housing zones and opportunity areas to inform development opportunities and challenges.

CASE STUDY: QUEEN ELIZABETH OLYMPIC PARK AS A GLOBAL SHOWCASE FOR SMART TECHNOLOGY

Jim Wood, Director of IT & Information Services, London Legacy Development Corporation

Queen Elizabeth Olympic Park is implementing new innovations in technology to be a testbed for transport, sustainability, and connectivity

CASE STUDY: QUEEN ELIZABETH OLYMPIC PARK AS A GLOBAL SHOWCASE FOR SMART TECHNOLOGY

Jim Wood, Director of IT & Information Services, London Legacy Development Corporation

The London Legacy Development Corporation (LLDC) is the Mayor's body in charge of developing and regenerating Queen Elizabeth Olympic Park and the surrounding area, building on the 2012 Olympic and Paralympic Games legacy.

As part of its overall plans, LLDC's ambition is to harness technology to create a world class experience within the park, showcase systems in use and to facilitate regeneration of the wider area of east London.

The Park includes the major new development, Here East, a one million square foot digital quarter for east London. The former Press and Broadcast Centres will offer the most advanced digital infrastructure in Europe, as well as commercial spaces of all sizes and a training ground for new digital talent.

The Park provides a unique opportunity to act as a testing ground for Smart City initiatives and as such LLDC are working with a number of commercial companies, academic institutions and government / EU funded agencies including the European wide Smart Sustainable Districts (SSD) programme. This builds on smart and sustainable solutions already implemented at Queen Elizabeth Olympic Park and supports enhanced and new initiatives. The key areas of focus are:

1. Resource efficient buildings: aims to enable a solid understanding and optimisation of the venues, starting with the Copper Box Arena and the London Aquatics Centre, to ensure that the Park is an exemplar during legacy use. This will inform future building developments.

2. Energy systems: creating an efficient, smart low carbon, resilient energy ecosystem. This builds on the existing Distributed Energy Network.

3. Smart Park and Future Living: is looking at implementing user facing digital and data solutions that are essential to the overall objectives of SSD of financial and CO_2 efficiencies; more efficient Park Operations; and enhanced user experience but with particular focus on the latter. This supports the LLDC Visitor Strategy.

4. Data architecture and management: is looking at implementing efficient and robust data management solutions that both support the identification and trialling of innovative solutions and provide the foundation for improved park operations, user experience and approaches that can be replicated by others, including through the London Data Store.

Another linked initiative is implementing environmental and fauna sensors in the Park as an Internet of Things demonstrator with associated research into how visitors and residents can become engaged with this type of initiative through the use of innovative and fun technology.

Other initiatives make use of technology on the Park and will do so into the future as the Park is further developed for housing, employment and the Olympicopolis cultural and education quarters.

CASE STUDY: QUEEN ELIZABETH OLYMPIC PARK SMARTER ENVIRONMENT

Jennifer Daothong, Senior Sustainability Manager, London Legacy Development Corporation

The London Legacy Development Corporation (LLDC) has embarked on an ambitious programme with stakeholders to use the latest innovations in technology and approach to reduce operational carbon emissions and increase the resource efficiency of Queen Elizabeth Olympic Park and its new neighbourhoods. In order to do this the LLDC is:

- Ensuring all new homes delivered on the Park are provided with smart meters capable of providing real time information on energy and water consumption

- Working with partners to deliver a smart homes trial with residents to improve district energy network efficiency and capacity without compromising thermal comfort or convenience

- Field testing distributed sensor networks to provide local environmental context (temperature, wind speed and direction, sunlight, air quality) to building and renewable energy generating operational performance

- Modelling the thermal performance of buildings to understand the design – performance 'gap'

- Reviewing a range of additional renewable energy opportunities and patterns of ownership to increase district-level resilience

- Working to build on the potable water savings already achieved by the UK's largest waste water recycling plant at Old Ford (250million litres) with new developments coming forward

- Establishing a data platform to integrate disparate data-streams and make real time environmental data openly available

- Working with partners to interrogate supply chains to better understand circular economy value chains

- Exploring the opportunities to integrate electric/hydrogen vehicle infrastructure with energy networks.

1.3 Infrastructure to support London's future growth

We said we would:

- Investigate how data and digital technology can both inform and help meet London's long term infrastructure needs. **As part of this, in August 2015, we published the first London Infrastructure Mapping Application (IMA LDN) with the support of the London Infrastructure Delivery Board. It combines planned and estimated development activity with infrastructure providers' investment decisions. The aim is to incentivise greater cooperation among all providers and shape decision-making.**

- Work with public and private partners to identify and enable common data standards for the Mayor's Long Term Infrastructure Plan. **The Infrastructure Mapping Application will build a common data platform that can influence more efficient infrastructure planning, delivery and coordination in the sector.**

- Publish a Long Term Infrastructure Investment Plan by 2015. **A full consultation report of the Infrastructure Plan 2050 was published in July 2014, and an update report in March 2015. We're looking to develop several programme areas of the plan (See more on the infrastructure 2050 website).**
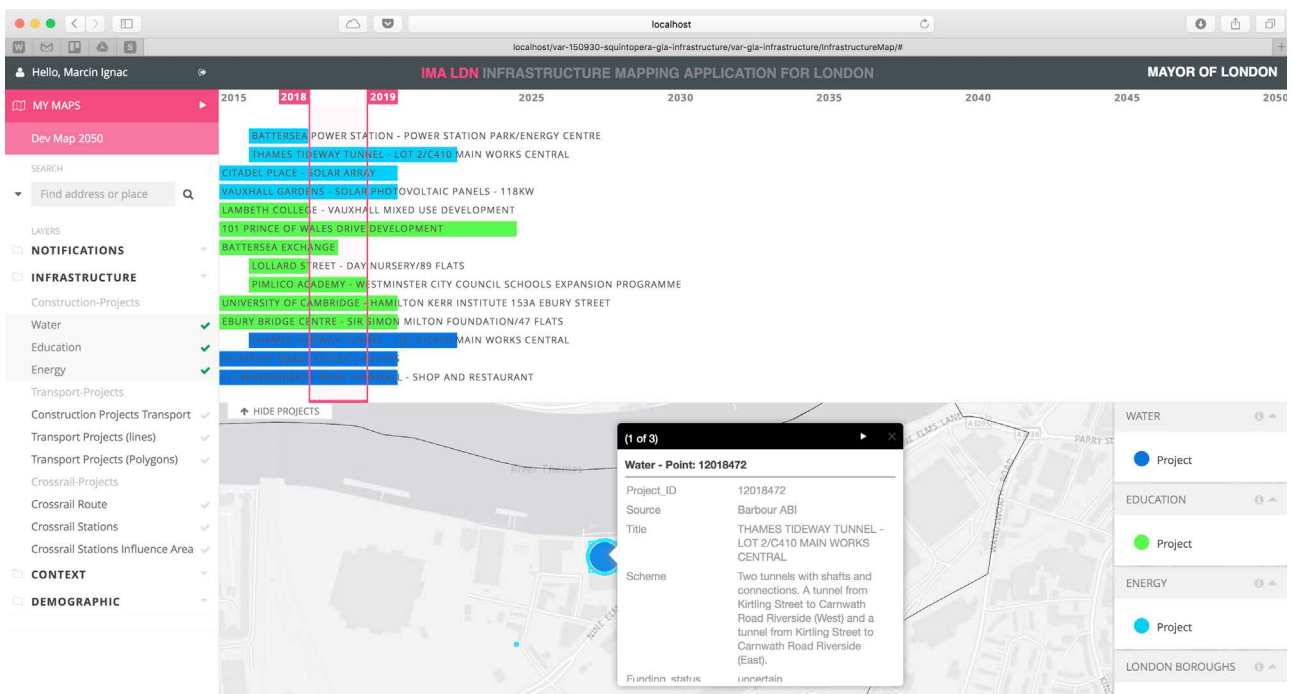
The London Infrastructure Mapping Application: Timeline of future projects

- Measure the success of the infrastructure plan through plans for open data release which conform to open standards. **Open infrastructure data from the Infrastructure Mapping Application has been up on the London Datastore since August 2015. We have also been releasing environmental data to open standards. An example is the data from 5,567 smart meters from London households in network operator UK Power Networks' Low Carbon London project. We're going beyond just open data by offering a secure data sharing environment where we must protect our residents' privacy and our businesses' commercial assets.**

- By 2020 showcase a robust 3D map of all London's underground assets, accessible and updateable in real-time by all asset owners and works planners. **We commissioned a report in 2015 to investigate the opportunities and limits that utility firms face sharing information of their underground assets in London via a common platform. Significant information and coordination barriers still need to be overcome in a cost-effective manner for the 3D map to become reality. We aim to do this in the next five years, for example by testing the business case for data sharing with the OPDC and with CASA's work with Queen Elizabeth Olympic Park. We're also testing the technology market by proposing this as a challenge through the Smart London Infrastructure Innovation Network.**

CASE STUDY: LONDON INFRASTRUCTURE MAPPING APPLICATION (IMA LDN)

Madalina Ursu, Principal Policy Officer for Infrastructure and Competitiveness, Greater London Authority
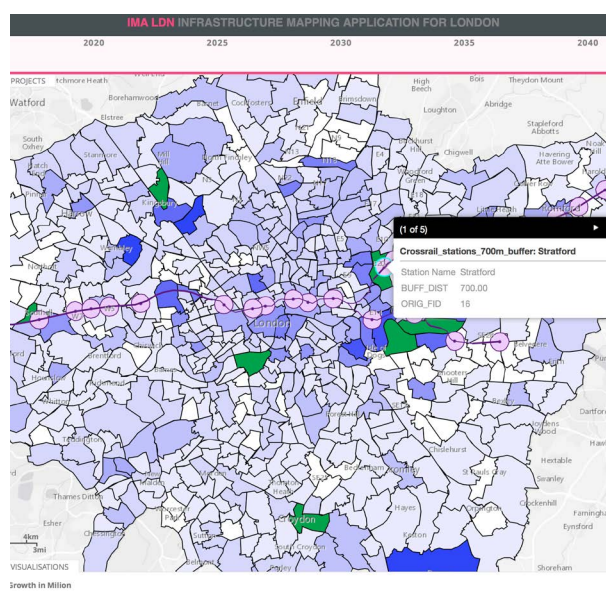
We created the Infrastructure Mapping Application as an online database to better understand the phasing of projects and the synergies and tensions growing in London. It considers the total impact of development, the potential for greater coordination of utilities works and the ability of our road, energy, waste, and water systems to respond to London's growth – both in the short and long term. The map was a London Infrastructure Delivery Board commitment to support a more joined-up and forward-looking approach to infrastructure planning and delivery.

Over the past few months, we've mapped planned and projected development activity (using the London Development Database and extra information on planning activity using Barbour ABI data). We have also planned and expected future investment decisions (integrating information from infrastructure providers over the short and medium term). In addition, we have layered information on top of population projections, green belt margins, expected opportunity area boundaries and more. Together with refining this information, we will build on this work to include other elements that inform decision making in this space.

This includes the capacity of the existing infrastructure systems, a skills analysis for delivering the envisioned level of

activity, funding arrangements in place for each project and others. While still work in progress, this should inform investment decisions and give infrastructure providers incentives to cooperate.

We have been working closely with major infrastructure providers and advisors and we are grateful for their involvement to date. We will continue to work with key stakeholders to improve the analysis and presentation of the data and what information alerts we could employ to make the map easier to use in decision making processes.

The London Infrastructure Mapping Application: Crossrail and projected population growth

1.4 Moving London

We said we would:

- Trial new technologies that will reduce the likelihood of collisions with cyclists and other vulnerable road users, such as proximity sensors. **In summer 2015, Transport for London trialled two different detection systems on London's buses; one system employed advanced cyclist detection technology with both radar and optical technology to detect cyclists nearby, and gives the driver an audible warning. Another system detected pedestrians, cyclists or motorcyclists on a collision course with the vehicle, giving a visual warning and an audible alert to the driver**

- By 2016, develop a robust quantitative understanding of the contributions that smart technical solutions and associated services can make to the management of London's transport and environmental infrastructure. **TfL's Innovation and Safety, Quality & Service Development Teams created an assessment tool to identify value drivers missing from business cases. These include quantifiable business improvements, lowering capital expenditure and operating costs, reducing disruption time, and revenue opportunities. We will consider and assess the need for an understanding of environmental infrastructure as part of our Smarter Environment for London work.**

- Experiment with new ways of reducing light freight; especially reduce white van deliveries associated with increased e-commerce. **The Agile Logistics project is run by the**

Smarter Environment team at City Hall. It studies how we can reduce the number of journeys made by e-commerce vans by helping them to share loads, deliver to local consolidation points in bulk rather than to individual premises, and reduce the number of failed deliveries. We're looking at options like moving deliveries out of central London and to off-peak times, promoting the use of greener vehicles including financing, changing routes to avoid congestion, and encouraging companies to collaborate.

© London Borough of Greenwich

Innovating in transport from the Santander Cycle Hire Scheme today to the GATEway driverless car project funded by Innovate UK for the future

CASE STUDY: ORIGIN DESTINATION INTERCHANGE (ODX)

Lauren Sager Weinstein, Head of Analytics, Customer Experience, Transport for London

TfL has developed a new tool in partnership with the Massachusetts Institute of Technology (MIT). The Origin Destination Interchange (ODX) algorithm has been designed to better understand customer movements around the bus network and support network planning.

ODX uses data generated by iBus (automatic vehicle location) and Oyster. This is combined with advanced analytics, to infer bus journey destinations. ODX has provided a wealth of new data about travel behaviour. It infers destinations for 75 per cent of bus journeys. This provides a comprehensive picture of travel patterns, offers major benefits, and allows us to find new and innovative solutions to our business questions.

ODX has been used in a range of practical applications from planning and redesigning the bus network to improving customer travel experience.

When Putney Bridge closed for repairs in 2014, bus services had to terminate either side of the bridge. However people were still able to walk or cycle across. We used ODX to predict the impact on bus passengers. ODX identified that roughly half of these journeys required no transfer as they started or ended very close to the bridge. The other half of journeys crossed the bridge mid-trip and would require a bus trip either side of the bridge. Consequently we offered transfer facilities so customers weren't charged twice and sent targeted emails providing customers with information on alternative routes.

Using ODX, the bus network serving New Addington has been completely reorganised to better serve passenger needs. In 2015, ten routes were restructured to redistribute capacity to better meet passengers' requirements. The restructure is more efficient, with savings reinvested to improve reliability and provide a new link to Purley, via route 359.

CASE STUDY: DECISION-MAKING AND USER TESTING USING VIRTUAL REALITY TOOLS

**Kuldeep Gharatya,
Head of Technical Strategy,
London Underground (LU)
Technology & Innovation Team**
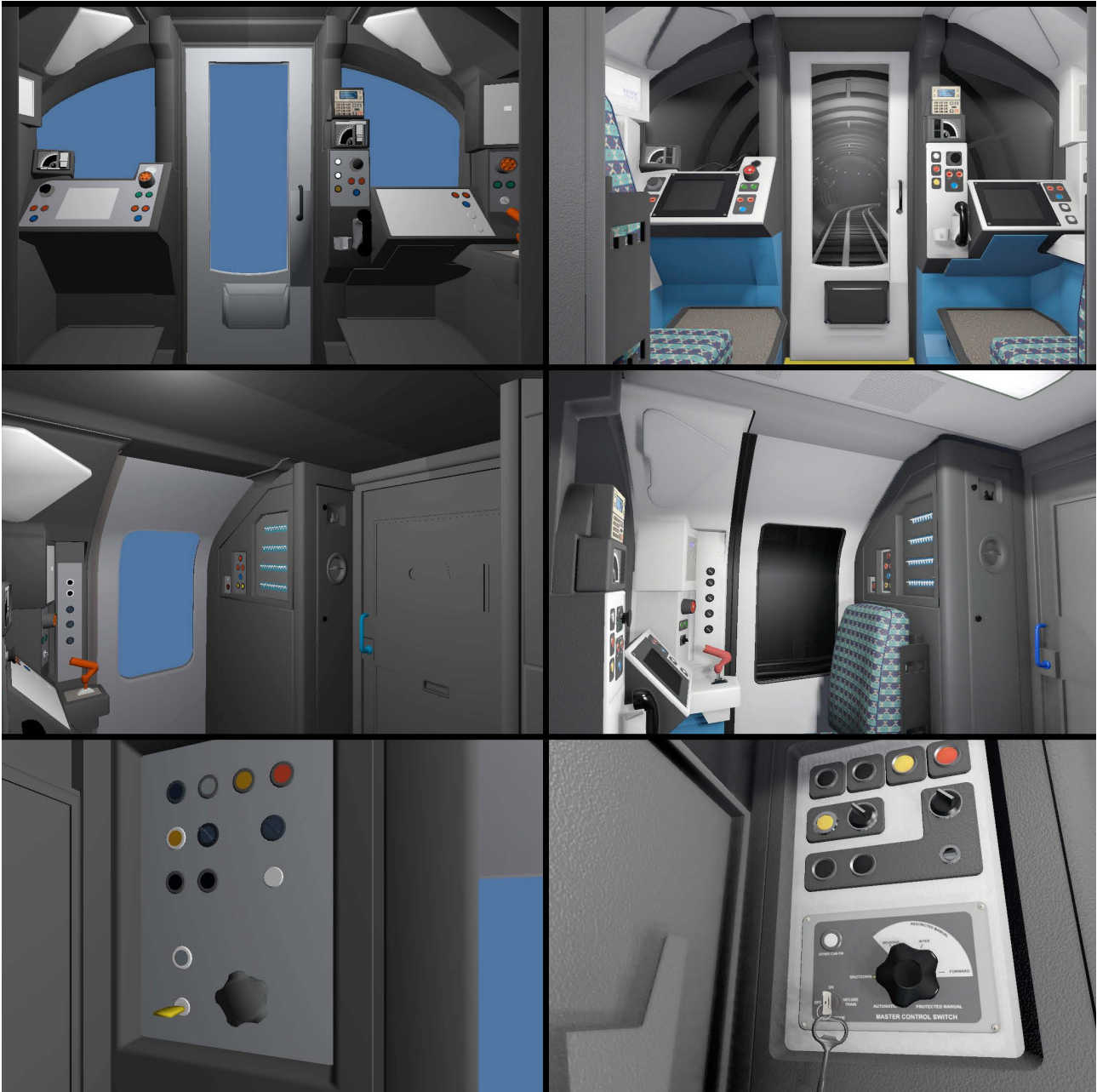
One of the key challenges of a future smart city is how to process, visualise and act upon large quantities of data that will arise from connected devices and sensors. © Transport for London

London Underground's Technology and Innovation team have been leading the business on piloting these tools such as Virtual Reality (VR) environments to visualise and exploit these datasets. They give a level of detail and involvement that was not previously available. Visualisations are now no longer static or restricted to subject matter experts who are familiar with telemetry outputs.

These visualisations put decision makers into a virtual environment modelled on the ones they see in their everyday lives. It allows instant familiarisation and new business opportunities can be found intuitively.

The team are currently exploring a number of opportunities including assessing crowding and passenger behaviour in stations, fault finding in a replicated train cab using telemetry data and general site/driver training.

Users are being placed into a virtual model of a station to see how effective new station signage positioning is or how visual digital displays can relieve boarding and alighting congestion. Crowds can be given artificial intelligence within scenarios and their behaviour seen in real time.

An interactive VR train cab identical to the ones on our network can help with fault finding and training. Since a number of faults can be easily simulated within the virtual environment, training for operations, and finding and resolving faults, will cost less than traditional methods.

These virtual models are being connected to external data feeds to reflect real time or historical conditions such as carriage occupancy levels. Fault finding training in cab environments can also be based on captured telemetry data to provide realism and case study reviews.

CASE STUDY: DELIVERING A WORLD-CLASS RAILWAY INNOVATIVELY

John Pelton MBE, Strategic Projects Director and Head of Innovation at Crossrail

The Crossrail innovation programme, Innovate 18, was set up by its Chief Executive Andrew Wolstenholme, supported by a team from Imperial College led by Professor David Gann, in 2013. It aims to respond to a growing demand for innovation on major construction projects and programmes. It is a pioneering and transformative initiative that is now on the verge of being established as the foundation of a UK industry wide programme.

Innovate 18 sets out how we would take a systematic approach to innovation on Crossrail. It emphasised the need for commitment from all those people and organisations involved in delivering Crossrail. It also established sharing mechanisms and behaviours as the keys to success. The strategy set out three central themes to direct the programme. One of these was 'Digital Physical Integration' with a specific priority for BIM and smart technologies. This reflected the increasingly digital context of the industry, but also the story of the Crossrail project which has tracked the evolution from CAD into BIM and the huge potential that is being unlocked as these technologies develop.

The Crossrail BIM team saw the opportunities created by the innovation programme and have built on their own pioneering work to maximise the benefit to Crossrail. Innovations like the Crossrail BIM academy and the development of a collaborative common data environment have set new standards for the industry. They have enabled further innovation by creating the conditions for working in a collaborative 3D environment. The use of, for example, immersion facilities have provided the opportunity for users to 'get into' the models rather than working from a 2D screen. Teams have been able to work together in this environment conducting activities including design reviews, health and safety reviews and general spatial problem solving. As the programme now starts to focus on the needs of the future asset managers, Crossrail is planning an intelligent method of providing operating and maintenance information to Rail for London (RfL – the Crossrail infrastructure manager).

The innovation programme has supported this BIM 'spine' at every stage. Application programme interfaces (APIs) have been developed to allow interchange of documents between management systems. This has allowed pioneering solutions like 'red-lining' (the final adjustments to the 'as built' drawings to reflect any changes between design and construction, traditionally done with a red pen) of the BIM data directly from a tablet on the construction site. Applications have been developed which streamline process and accelerate approvals through electronic signing. Examples include health and safety reporting as well as testing and commissioning approvals both of which can be undertaken using handheld devices. This dramatically speeds up

Tunnel inspections near Fisher Street, Holborn.
© Crossrail

response time and provides information in a more useable form. As the railway systems works are undertaken to help fit out Crossrail with the infrastructure and technology required to become a fully operational railway, huge improvements in productivity and quality are being achieved. An example of this includes the use of a state-of-the-art drilling rig being used to drill more than 250,000 holes required to accommodate the brackets for cabling, walkways, fire mains and over head electricity lines inside the tunnels. The system positions itself within the BIM environment, automatically locates and drills the holes and records them. It not only achieves high accuracy and more rapid installation, but also removes the need for people to physically carry out the work, greatly reducing the associated health and safety risks.

In parallel, Bombardier has been manufacturing the new Crossrail trains, which will be some of the most highly digitised trains on the UK's railway system. Reliability, maintainability and efficiency will all be significantly improved through the use of remote condition monitoring systems fitted on the trains. At the same time they will be integrated with digitised signalling systems, digitised control and passenger information systems as well as driver operating systems.

Crossrail will, therefore, be the UK's most modern railway when the first trains start operating beneath London at the end of 2018. It can already claim to have pioneered an approach to innovation that has set the standard for the infrastructure industry as a whole.

CASE STUDY: USING INNOVATIVE TECHNOLOGY ON BUSES TO IMPROVE VULNERABLE ROAD USER (VRU) SAFETY IN LONDON

Katherine Stretton, Principal Policy Officer – Transport, Greater London Authority

London's bus fleet is one of the safest in the world. Bus trips account for over a third of all road journeys in London - more bus journeys than in New York and Paris combined. Yet, buses and coaches are involved in only eight per cent of all road collisions resulting in an injury. Between 2012 and 2014, there was on average 200 people killed or seriously injured in collisions involving buses or coaches per year. Buses and coaches are also disproportionately involved in collisions with pedestrians and cyclists, relative to their traffic mode share.

In light of these figures, and the fact that any injury involving a bus is one too many, Transport for London (TfL) has been pioneering new vehicle technologies. This is part of the Mayor's bold plans to prioritise the safety of VRUs - pedestrians, cyclists and motorcyclists - which make up around 80 per cent of all serious and fatal collisions on London's roads. In 2014, TfL undertook a groundbreaking trial using innovative detection software on London buses to better understand the role of detection technology in reducing collisions between buses and VRUs.

Four buses, two on route 25 and two on route 73, were fitted with brand new optical and radar-based detection technology, designed to alert drivers to at-risk pedestrians and cyclists. The trials involved two different detection systems; one system employed advanced cyclist detection technology which uses both radar and optical technology to detect cyclists nearby, with the system audibly alerting the bus driver to their presence. Another system detected pedestrians, cyclists or motorcyclists in a collision course with the vehicle, giving a visual warning and an audible alert to the driver.

The six-week trial found that drivers have many things to focus on at once when driving a bus, so the technology must be simple, accurate and easily understandable to be effective. If audible warnings go off too frequently, drivers will not adequately associate them with a potential hazard or danger. The trial concluded that the technology must precisely and accurately discern and respond to a VRU's presence in a timely way or there is the risk that drivers will not pay attention to it.

TfL is currently reviewing these findings of the detection technology trial to determine the next steps in adopting these innovative technologies.
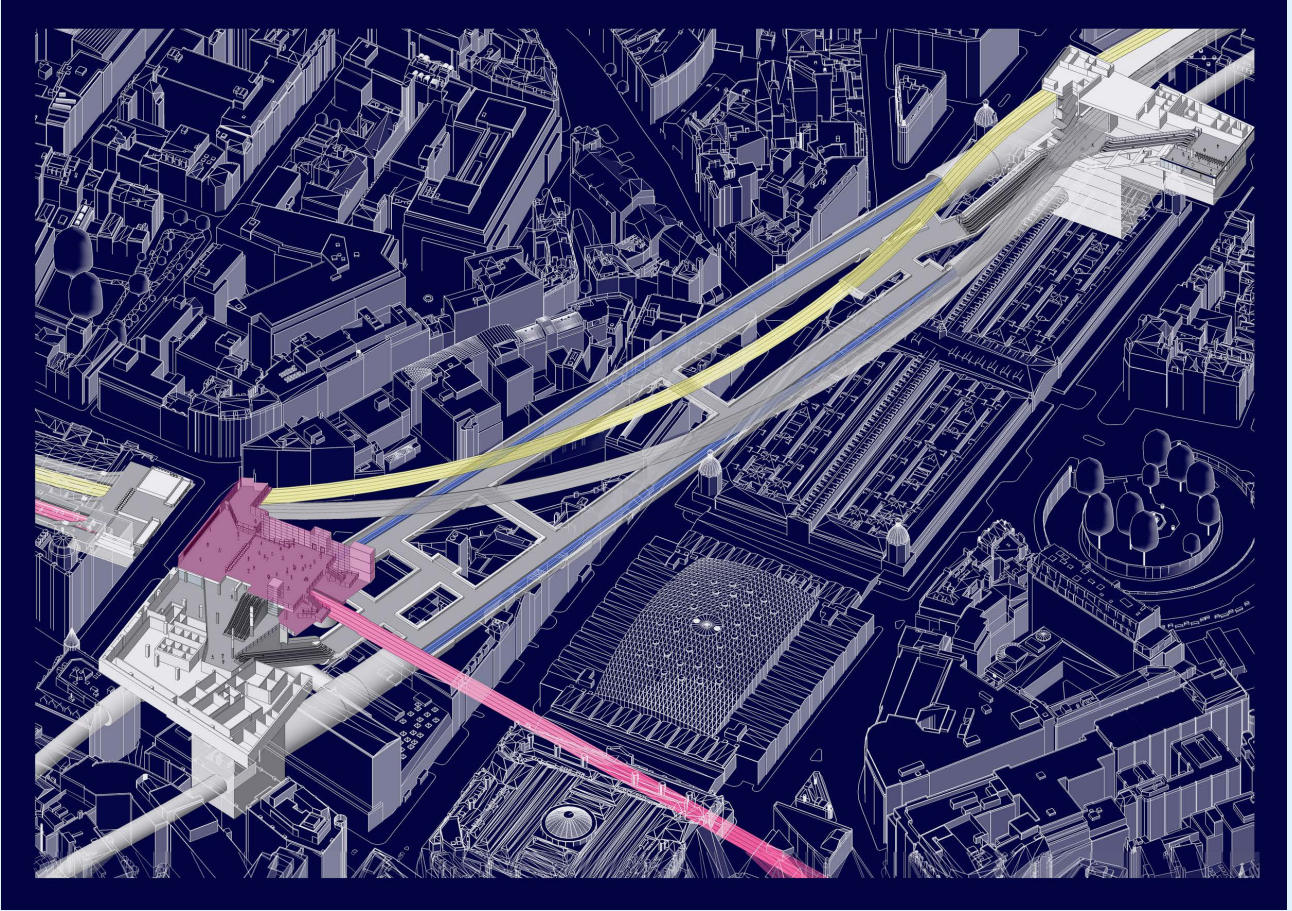
© Crossrail

2 Future opportunities

The Smart London Board has made the following recommendations for the next Mayoral term.

2.1 Harnessing data to solve city challenges

The Mayor should:

• Develop a data strategy that makes open data more available and provide access to secure data sharing options with central government and private sector service providers. This will stimulate further innovation in realms that require more secure data sets, such as health

• Examine options for enhancing city leadership in data and technology. This could take the form of any or all of the following: a Chief Technology Officer, a Chief Information Officer, or a Chief Digital Officer – with the Chief Digital Officer as the recommended option by the Board. In addition, London requires a Mayoral advisor with the necessary political power to cross boundaries and silos.

• View city data as part of a platform where developers are encouraged to use technology to creatively improve and redefine the functions of government services. The Mayor should build systems that can cope with the 'city as a platform' capacity. This will make it easier to harness the technological capabilities in London. If we do not, we will fall behind other world cities, devolution will be slowed, and potential cost savings for frontline services will not be found. Public data should be released

that encourages developers to build services that increase trust between citizens, government, consumers and the private sector. The Digital and Future Cities Catapults should work collaboratively with City Hall to minimise the impact of privacy and security regulation on the innovation community. These public services should feedback to citizens how the data they generate can have a positive impact on service provision.

• Connect data sources in the Datastore to map human activity in the capital past and present to provide more predictive analyses.

• Work with London Councils and others to aggregate demand for IT services and move to cloud storage and computing. London's government should, for example, explore ways to collaboratively maintain core data assets such as air quality, land assets, food quality ratings and maps publishing the resulting data sets as open data that anyone can use.

• Understand the role of the boroughs and their elected leaders and cabinet members to push 'smart' to manage good growth. This includes using the Borough Data Partnership to study how innovations can improve public services, the City Data Strategy for the range of approaches available, and the sites the GLA controls to prove solutions. They should investigate creating a GLA innovation hub to understand what boroughs need and what the market can provide today and tomorrow.

- Build big data and advanced analytical capacity through strong(er) partnerships with, amongst others, the Centre for Urban Science and Progress in London, the Imperial Data Science Institute and the Digital Catapult.

- Show the private sector how the code and data works in the Datastore as a catalyst for ideas.

- Gather high resolution data on the maintenance and operation of public and private rental housing stock to reduce the operating cost for RSLs and PRS operators. This will in turn help to stimulate the growth of these sectors.

Londoners and businesses should:

- Make proposals on data governance, or how they secure and share data, in London's governments. The Smart London Board should itself make recommendations on data governance, and what programme designs and regulations will join up different silos.

- Use digital technology to create high quality places. Examples include the use of local community social media networks, smart concierge systems, data-rich public spaces and the use of 'playful' smart technology. All of these can contribute to creating high quality sustainable development.

- Think about how London's data from all sectors can help you - for example, how can freight vehicles currently driving with an empty load through London's roads between jobs be put to more efficient use?

- Embed digital infrastructure in new housing to build the next generation of smart, connected lifetime homes. These homes will enable independent living for longer. For example, elderly people who have trouble bending can use their smartphones to turn on lights or heating on and off. Or the visually impaired can use voice activated TV guides to change channels.

2.2 Smarter Environment

The Mayor should:

- Make the case for easing the regulatory barriers for smart energy services and infrastructure, and encourage future progress

- Support open demonstrators that measure and respond to environmental (water/waste/energy/urban greening/air quality) data in real time

- Develop an innovation investment programme supporting scalable smart environment solutions (digital, tech, co-design etc.) and services through competitions/accelerators focussed on solving environmental challenges. The innovation programme should identify water, waste, food, air, and energy system challenges for London as market opportunities for the technology and data sector. It should provide seed funding for new applications, products, or services that will turn into sustainable ventures.

  A co-design process, built into the innovation programme, should guide applicants to develop ideas that show potential to become viable business propositions.

- Assess the need for a robust quantitative, including financial, understanding of the contributions that smarter technology/data approaches and solutions can make to the design, delivery and management of London's enabling environmental infrastructure.

- Design, manage and mainstream, supported by technology and data, the concept of London's multi-purpose natural environment, green spaces and green elements, to maximise the services they can provide.

Londoners and businesses should:

- Invest in smart energy solutions. Energy is a critical and vulnerable city system, and more investment should be encouraged in technical solutions of all kinds.

- Invest in innovations to ensure that London's water system is secure and resilient to the current weather and future climate.

2.3 Infrastructure to support London's future growth

The Mayor should:

- Build on the London Land Commission's work to create a register of publicly owned land and property to use public land, the roofs of our buildings, and the lamp posts and street furniture in our streets, parks, and open spaces to build digital infrastructure.

- Work with individual regulators, UK Regulators Network to consider potential changes, to current regulatory systems that could achieve higher efficiencies and cost savings for consumers and the economy as a whole.

- Do more with less - Ask Londoners for ideas of disused pieces of infrastructure around their areas that could be used for more productive purposes; visualise on a map and start building a system of disused infrastructure across London.

- Explore crowdsourcing/funding/ financing of ideas to solve London infrastructure challenges.

Londoners and businesses should:

- Share London's utilities' resources flows and investment plans to meet the capital's future growth. They should show how much of their infrastructure budget is spent on technology – we expect to see this figure rise to 20 per cent in the near future.

- Make telecoms providers' national data on performance and need available at a local level. We need London-specific and neighbourhood-specific data on a dashboard accessible to all to understand supply and demand, and ensure this works for the city.

- Anticipate demand by piloting and testing new ways of designing infrastructure before it is needed. The London Infrastructure Mapping Application should help stimulate this innovative approach.

- Create applications that could be useful for those involved in planning or delivering London's infrastructure and suggest different technology solutions that exploit the power of digital to do things more efficiently and drive down costs.

- Use utility capacity studies, buried utility location mapping and environmental impact assessments to mitigate development risk and improve development viability.

2.4 Moving London

The Mayor should:

- Maximise use of next generation smart car share schemes, automated personal rapid transit systems and adaptive public transport route planning and timetabling to improve connectivity. This can unlock development potential, particularly in London's opportunity areas where the level of public transport accessibility is more limited.

- Use digital technology to help develop a data-rich evidence base that supports the development of transport planning. The risk associated with planning new developments have a direct impact on the total cost and therefore their viability.

- Renew London's transport infrastructure and minimise transport disruption using digital tools and continue to use smart technologies to smooth out peaks and ease overcrowding and congestion. Scale-up solutions being piloted by Transport for London and the boroughs through TfL's Innovation Fund and Future Streets Incubator Fund. These are an implementation challenge and opportunity for the public sector and the developer community.

- Use public assets and digital technology to cut the time it takes to serve any system faults.

- Examine the pressures that technology has made on London's scarce road capacity, from utility services and package delivery to private hire vehicles.

[5] Enabling technical innovation in the GB rail industry: barriers and solutions, RSSB, 2010

- Use technology to build a meaningful, collaborative relationship with customers that makes them feel like they are informed users and owners of the public transport system.

Londoners and businesses should:

- Show how to present and visualise data and engage with other Londoners around smarter day-to-day travel and transport life in the city.

- Explore virtual and augmented reality technologies to help us design, refit, renew and build the transport network and mobility services.

- Overcome innovation barriers in the rail industry from a lack of a holistic view, lack of research and prototyping capability, and perceived implementation risks[5]. This will help improve the reliability of assets and services by detecting where they are at all times. It will also minimise closures through technologies that maximise what can be done at such times, and improve information for passengers using internet and mobile technologies.

[6] Oxford Economics commissioned by London & Partners, July 2015
[7] CB Insights commissioned by London & Partners, October 2015

WORKING WITH BUSINESS

The number of digital technology businesses in London increased by over 12,000 between 2010 and 2015. Latest estimates suggest they number around 40,000. Venture capital investment into Britain's technology sector has reached a record high with London-based companies securing around 62% of the $3.6bn raised by UK firms in 2015. London is clearly a place where businesses can go to 'scale-up' their ideas.

We have an opportunity to tap into talent across all sizes and types of technology businesses. London's innovation ecosystem is dynamic. It encompasses entrepreneurs, investors, researchers, venture capitalists with business development and other service providers such as accountants, designers, manufacturers and providers of digital skills and professional development needed to make innovation happen. City Hall can help by collaborating with innovators and promoting new ideas to make London run better.

1 What we said we would do and what we did

We said that we would enable innovation networks and demonstration projects in transport, environment, and regeneration. We said that we wanted London's technology entrepreneurs to help City Hall develop new ways of delivering public services. The Mayor has a critical role to play harnessing this activity.

1.1 Innovative businesses taking on London's challenges

We said we would:

- Scale up innovation, working across borough boundaries and service providers to identify strategic opportunities for applying data and technology to London's challenges. We also said we'd look at how innovations can be rolled out at scale (in applications such as parking, waste collection, or healthcare) via a Smart London Innovation Network by 2014. **We have created two Smart London Innovation Networks. The Smart London Districts Network, launched in 2014, brings together public and private development organisations building London's most ambitious growth areas. The Smart London Infrastructure Network, formed in 2015, is made up of organisations delivering London's infrastructure including water, gas and electricity with others looking to join.**

- Host Smart London investor days to attract the global finance that will help emerging solutions to be more rapidly commercialised. **The Smart London Districts Network held an innovation event for businesses to pitch their solution to two challenges. The first, for 'Smart Wayfinding', sought smart innovations which would help residents, visitors, businesses and developers better connect with their surroundings. The second, 'Connecting People and Creating Communities', sought smart solutions which could be used to help connect people with others in their district as well as with the places they live, work and visit, creating a sense of place. In March 2016, City Hall hosted an investor showcase for the tech community to showcase London's emerging innovation across keys sectors including smart infrastructure and health.**

• Establish Smart London as a vehicle to help meet London's diverse needs; challenge London's technology community to innovate with new approaches to health, training and social care. **In February 2016 the Mayor, MedCity and London's Academic Health Science Networks launched Digital Health London, a pan London initiative to help digital innovation to better meet London's health challenges. This includes a three year Digital Health Accelerator programme to support digital health SME growth. The Mayor and MedCity have also been working with SEHTA (South East Health Technology Alliance) to develop a Med Tech Network for London to help support the innovation and growth of med tech SMEs. Most recently we have been developing a co-design citizen engagement programme that will work with Londoners to identify wider opportunities for co-designing smart products and services to meet Londoners' needs.**

• Ask technology entrepreneurs to help City Hall develop more innovative approaches to service delivery. **We have partnered with the private sector to create Tech.london, an online guide to the start-up community - including events, training, workspace and jobs - in London. The site has supported a Smart City Challenge, working with Urban Design London (a network of London borough urban design officers) to help address transport, housing, and planning challenges.**

We have held Datastore coding workshops for tech entrepreneurs to demonstrate how code and data works. As a catalyst for future ideas on the use of city data, we created the MyLondon site, an interactive and personalised dashboard that helps people who are moving home find areas of London that suit their needs.

Digital Health London can be found at digitalhealth.london

Cybercrime is a growing threat for London's businesses, but London has the expertise to help grapple with the challenge. The London Digital Security Centre (LDSC), a public-private sector partnership created by MOPAC (Mayor's Office for Policing and Crime), is working to secure and protect London's SMEs against cyber risks and threats. LDSC publishes information online and runs monthly masterclasses on cyber security topics in partnership with the Federation of Small Businesses. The LDSC also offers subsidised business services to micro, small and medium size businesses to secure their digital infrastructure against attacks from cyber criminals.

- Develop an index to benchmark global progress on digital money and establish a digital money demonstrator by the end of 2015. **Imperial College London founded their Centre for Cryptocurrency Research and Engineering in November 2015. The goal of the Centre is to become a leading international centre for research and application activity related to cryptocurrency and blockchain (often known as bitcoin) technology. Together with Citi, Imperial published a digital money index in 2014 to measure government and market support, financial and technology infrastructure, presence of digital money solutions, and countries' tendency to adopt these technologies. The findings reflect London's leading role in financial technology (FinTech) innovation.**

CASE STUDY: HORIZON 2020 SMART CITIES LIGHTHOUSE: SHARING CITIES

Andrew Collinge, Assistant Director, Intelligence, Greater London Authority

This prestigious Horizon 2020 (H2020) project will develop, deploy and seek to integrate replicable solutions in the energy, transport, data and ICT sectors. In demonstrator areas it will also test the replicability of these physical, digital and human systems to deliver sustainable place and resource management opportunities. Successful delivery of Sharing Cities will place London firmly at the front of global developments in smart city development.

There will be one demonstrator area in each of the three lead cities of London, Milan, and Lisbon. Demonstrator areas will take into consideration:

- Complex urban challenges linked to significant economic and population growth, where solutions are thought to be scalable and transferable.

- A varied urban setting including well established residential communities and businesses, alongside major redevelopment schemes.

  - A significant inward and outward movement of employees and visitors.

  - Strategic assets for low-carbon transformation in the H2020 timeframe – by 2020.

  - Key transformation projects/plans currently being implemented or scheduled for the near future.

  - Existing infrastructure assets.

The Demonstrator area for London is the Royal Borough of Greenwich (RBG). Other partners include: Transport for London, Imperial College, KiwiPower, UrbanDNA, Concirrus, Mastodon C, Siemens UK and Future Cities Catapult.

CASE STUDY: PROCUREMENT OF SMART SOLUTIONS FROM INNOVATORS

Kuldeep Gharatya, Head of Technical Strategy, London Underground (LU) Technology & Innovation Team

Public authorities cannot make the transition to an enabled Smart City alone. London Underground's Technology and Innovation Team has been spearheading a number of collaborative innovation partnerships. These include academia, SMEs, new suppliers as well as our existing tier 1 suppliers which will deliver technology proof of concepts.

The benefits of the Team working with new SMEs and unconventional suppliers is that these partners are not constrained by existing thinking and are willing to explore new and unproven concepts in an agile manner. The Team also has the legal and commercial acumen to undertake agreements that protect our background Intellectual Property and ensure fair public sector ownership of any valuable project outputs.

The Team has been successful at securing external innovation project funding from a number of sources. This funding has allowed us and our collaboration partners to bridge any business case gaps by better understanding the commercialisation and internal business opportunities first. The risk and reward is shared jointly between the public and private sector.

The Team has provided a number of launch pads for new and emerging smart city technologies, by setting innovation challenges to be solved at a number of hackathons and SME competitions and industrial end user context.

A recent example is the IC Tomorrow for Innovation in Urban Spaces 2016 winner where the Team set the challenge to be solved and judged the submissions by engaging SMEs in presentations and Q&A sessions. The winning proposal was directly related to a potential future smart cities concept which will be trialled in the near future through the LU Technology and Innovation Team.

CASE STUDY: WITAN URBAN MODELLING PROJECT AND MASTODONC
Paul Hodgson, GIS and Intelligence Manager, Greater London Authority

London is recognised as a leader in the development of robust city models to inform the development of its policies. The GLA group has several specialist staff. They have developed and now operate these models in areas including population projection, job growth and transport.

However, city models are also a business opportunity in their own right, with the potential to provide employment for developers and data scientists in London. Recognising this, the GLA has been working with big data specialists, MastodonC to use the best of modern 'big data' and web-based technologies to create a new type of modelling platform. The project known as Witan will allow modellers to easily create and share variations of their models – and policymakers to explore different scenarios without the need to engage directly with the equations.

Complimenting this, we are also working with a new spin out from UCL's Centre for Advanced Special Analysis to apply their 20 plus years of research into modelling. Their work can provide outputs at the city level – right down to building level and includes advanced techniques such as agent-based modelling.

Both collaborations are made possible by Innovate UK's SBRI programme, and will lead to products which are planned to be sold by these London-based SMEs to cities across the UK and beyond.

CASE STUDY: SMART LONDON INNOVATION NETWORKS
Cathy Crawley, Director, BRE

Two Smart London Innovation Networks (SLINs) were set up to link London's entrepreneurs and innovators with organisations that deliver infrastructure and regeneration projects.

The Smart London Districts Network, launched in 2014, brings together public and private development organisations working on London's largest and most ambitious development districts. The Smart London Infrastructure Network is made up of organisations that deliver London's infrastructure services, primarily the utilities responsible for water and energy.

The Networks:

- Identify and link up existing and emerging smart city activity and investments

- Help clarify market opportunities arising from London's emergence as a smart city

- Support SMEs and the wider innovation community to seize these market opportunities and scale them up

- Provide a pipeline of targeted solutions to partners investing in London's smart infrastructure and services

The SLINs work to help make London's growth economically, environmentally and socially sustainable. They do this by identifying key challenges and stimulating digital technologies that will improve the lives of Londoners.

In 2015, the Smart London Districts Network developed two competition calls based on shared challenges:

- Smart wayfinding and navigation: smart innovations which would help residents, visitors and businesses better connect with their surroundings.

- Connecting people and creating communities: smart technology and data to help connect people with others in their district as well as with the places they live, work and visit, creating a sense of place.

Competition winners had the chance to pitch their innovations to an invited audience, including representatives from organisations some of the highest profile redevelopment districts in London.

Through the calls, 70 SMEs have engaged with network activity, with nearly 30 receiving a total of 100 hours of business support. This included pitch coaching and brokerage of one-to-one meetings with district developers. As a result, it is anticipated that at least two innovators will have the opportunity to pilot their innovations in a district.

Smart London Infrastructure Network activity is focusing on improving the shared understanding of utilities' combined underground asset base – both location and condition.

CASE STUDY: OLD OAK AND PARK ROYAL SMART STRATEGY

Peter Farnham, Principal Policy Officer, Old Oak and Park Royal Development Corporation

Old Oak Common is where London welcomes High Speed 2, and, the only place to change from High Speed 2 to Crossrail. This connectivity and once-in-a-lifetime investment is an opportunity to transform this part of West London into a sustainable, exemplar new district of London. It will deliver over 25,000 homes and 65,000 jobs over 30 years along with other economic and community benefits. In order to harness the investment and drive forward a single robust development plan for the area, on 1 April 2015 the Mayor created the Old Oak and Park Royal Development Corporation (OPDC). It is responsible for planning and regeneration of the area, which includes safeguarding and supporting the UK's largest industrial estate at Park Royal.

OPDC developed a Smart Strategy which will ensure that technology and smart thinking is at the heart of the regeneration programme. The Smart Strategy includes information relating to and improving the efficiency of infrastructure, energy use and how public space can be shaped and managed in years to come. It is a key evidence base document for OPDC's Local Plan and informs wider corporate planning.

OPDC is also in the process of establishing a Smart Advisory Group. This will comprise of a range of stakeholders and technology experts to help OPDC to deliver its smart city aspiration.

OPDC was supported by #HyperCatCity to develop the Smart Strategy. #HyperCatCity is an association of leading technology providers. They ran a number of workshops with stakeholders to examine how technology can help shape the urban design process, build sustainable communities and improve visitor experience.

OPDC also works with colleagues at the London Legacy Development Corporation, the GLA and UCL with support from #HyperCatCity to explore options for developing a smart digital model, to assist with the wider regeneration programme.

Visualisation of future growth around Old Oak Common station

CASE STUDY: ROYAL BOROUGH OF GREENWICH SMART CITY STRATEGY

Trevor Dorling, Digital Greenwich and Smart Cities lead, Royal Borough of Greenwich

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Royal Borough of Greenwich is using advances in technology, data capture and analysis, to support its spatial development and regeneration objectives, improve services, make optimum use of natural and financial resources, and ease pressure on infrastructure.

Greenwich published its smart city strategy in October 2015 covering four core themes:

- Using digital technologies to drive improvements in neighbourhoods and communities;

- Supporting the transition to a higher skilled, higher value economy;

- Improving services; and

- Strengthening digital infrastructure

Capitalising on the potential opportunities from 'smart city' technologies is core to Greenwich's approach. In 2015. Greenwich was chosen as a:

- UK pilot for Innovate UK driverless cars research;

- Horizon2020 EU Lighthouse smart city and community demonstrator, with the GLA;

- A host for the Open Geospatial Consortium's Future Cities Pilot; and

- A trial site for the introduction of home delivery robots

A new team, Digital Greenwich, has been set up to support the Council's work and oversee a new innovation fund. Alongside a new commercial venture, DG Cities Ltd, it will also work closely with business. Digital Greenwich also hosts a successful digital innovation centre that provides space for start-ups and small businesses.

CASE STUDY: FUTURE CITIES CATAPULT
Peter Madden, CEO, Future Cities Catapult

A participant testing during the Cities Unlocked project
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At the Future Cities Catapult, we support London's reputation as one of the smartest cities in the world.

We opened the new Urban Innovation Centre in Clerkenwell, hosting events and innovation challenges. It also is home to Ordnance Survey's Geovation Lab, Rockefeller 100 Resilient Cities, Igloo Regeneration and Intel's Collaborative Research Institute.

Small businesses and start-ups have been given support through advice, capacity building, and the ability to test and prove new solutions.

We've built international links, helping London-based organisations win work internationally and showing high-level global delegations how London and its businesses are tackling the challenges of our increasingly urbanised world.

And we've also brought a range of innovative projects to the city.

As part of 'Sensing cities' we've deployed novel air quality sensors and used beacons to support way-finding. In 'Cities Unlocked', we worked with Guide Dogs and Microsoft, (pulling in, too, the best

from across London's university research centres) to make cities more accessible for people with sight loss.

On urban big data, projects like 'Whereabouts London' have used data from the London Datastore to reinterpret the demographics of the capital. Another project brought London's data together for a live interactive exhibit at Somerset House, challenging visitors to shape the future of the city.

On citizen engagement, projects like 'Organicity', a collaboration between Aarhus, London and Santander, are developing methods that help Londoners be part of a city-wide network on environmental sensing. The major new project 'Sharing Cities' will put London at the forefront of showing what collaborative and smart approaches can deliver.

1.2 Smart connected businesses

We said that we would:

- Invest up to £24m in the provision of affordable ultrafast broadband to SMEs, and help up to 22,000 SMEs to gain access by 2016. **Delivery of the Super Connected Cities Programme nationally was re-scoped following state aid considerations. London has successfully delivered funding via BDUK's connection voucher scheme and a series of public WiFi funding. Together this amounts to over £21m in capital investment. It has also supported Over 12,500 businesses.**

- Ensure London has one of the fastest wireless networks globally and invest in wifi in galleries and museums.

In July 2015, the GLA launched its 'connectivity toolkit', which makes connectivity information available in an accessible format to be used by local councils, digital connectivity providers and Londoners. This includes the interactive connectivity map, which helps providers find suitable locations for rollout and allows Londoners to map their demand for fast connections on a neutral platform.

The Connectivity Rating Scheme rates and promotes the connectivity levels of commercial buildings. This both informs potential tenants and incentivises landlords to improve connectivity levels. The scheme is now live across London. Existing buildings and upcoming developments totalling

The Connectivity Rating Scheme can be found at wiredscore.london

over 12 million square feet have already received or committed to certification.

Over 80 public buildings and libraries across London have been supported to upgrade or install WiFi capability - world class cultural institutions such as the British Museum are among this number.

- Create a 'Tech City Institute' to promote the creation of digital products and applications and work with a range of local businesses, London's top tier universities and other skills providers to address higher level skills gaps. **We are working to meet this objective through our regeneration funds by supporting mentoring and apprenticeships schemes and business space in East London. One top tier university has created an innovation incubator near Old Street Roundabout. IDEALondon was established by UCL Advances, Cisco and DC Thomson to support digital innovation and start-up growth.**

Co-working space at the Geovation Hub, operated by the Ordinance Survey as the UK's mapping data lab

CASE STUDY: DIGITAL BUSINESS ACADEMY
Gerard Grech, CEO, Tech City UK

To increase the supply of skills and talent into fast growing digital businesses, Tech City UK has partnered with University College London (UCL) and other leading educators and businesses to create the Digital Business Academy (DBA), a free, online learning platform. Launched in November 2014, the DBA aims to give everyone in the UK the chance to learn the skills they need to start, run or join a digital business.

The courses include:

• Sizing up your idea;
• Understanding digital market channels; and
• How to track performance in digital businesses

The DBA also partners with leading employers to offer DBA graduates a range of career-enhancing opportunities. For example, for somebody looking to start or grow a digital business, rewards include fast track to start-up loans, free co-working space, mentoring, and ad credit. For somebody looking to join a growing digital business, rewards include attending exclusive recruitment events with start-ups, and a chance to be fast-tracked to final interview stage for internships.

1.3 Jobs and growth

We said we would:

- Export London's solutions to the world by supporting at least 100 SMEs through a Smart London Export Programme by 2016. **In 2014 and 2015, we took 105 technology SMEs on trade missions with our inward investment arm London and Partners and UK Trade and Investment in Mexico, Hong Kong, Australia, and New Zealand.**

- Lobby for a new visa to make it easier for talented global technologists to work here. **In October 2015, TechCity UK launched the Tech Nation Visa Scheme as part of the UK's Tier 1 exceptional talent programme.**

  This will support fast growth digital businesses to bring talent to the UK in order to scale up fast growing digital companies. This visa scheme allows entrepreneurs and small teams to come here from abroad.

- Support an employment increase to 200,000 technology employees by 2020. **In July 2015, we launched Tech.London a partnership between the Mayor of London, Gust, IBM, and a wide number of partners from London's technology community. It also supports the shared commitment to train the workforce of the future (and tackle skills gaps in London), help new business (and showcase them), and ensure London is at the centre of tech innovation.**

Oxford Economics reported in June 2015 that the digital technology sector within London currently accounts for almost 200,000 jobs, some 3.5 per cent of London's total workforce. The sector has created almost 30,000 jobs since 2010, an increase of over 17 per cent. This was far above the national average of 7.8 per cent. Digital technology jobs accounted for over three per cent of London's job gains from 2010 to 2015.

- Support a continued increase in the number of businesses who are 'innovation active' (at least by 10 per cent up to 2020). **Our relaunched London Business Survey found that 58 per cent (242,000) of businesses in London said they were 'innovation active' in 2013/14. We will continue to monitor this up to 2020 and we will announce the next survey in due course.**

- Support the continued increase in the number of SMEs winning public sector contracts or supply chain opportunities. **Transport for London (TfL) manages procurement on behalf of the GLA family. In February 2014, they launched a technology innovation portal that helps direct energy from SMEs into challenges from customer experience to safety. By August 2015, TfL has received 882 developed ideas via the portal and 116 have progressed as new projects or been incorporated into existing projects.**

CASE STUDY: UPSCALE
Gerard Grech, CEO, Tech City UK

The UK has suffered from a 'scale-up gap' that prevents promising companies from growing within the UK and expanding internationally. Therefore, on 28 January 2016, Tech City UK announced the first 30 companies to join the Upscale programme. Upscale is a six month pilot that provides some of the UK's fastest growing tech companies with world class advice from scale coaches, entrepreneurs and operators who have bought and sold businesses. The programme consists of a range of curated workshops and networking sessions, providing selected companies with the knowledge to scale past growth barriers.

The first intake of businesses reflects the growing diversity of the UK's digital specialisms. It also reflects the range of sectors being disrupted by data-led innovation, where growth businesses are using data analytics to help with everything from determining credit risk to choosing what to wear.

CASE STUDY: OPEN DATA INSTITUTE

Gavin Starks, CEO

The Open Data Institute (ODI) connects, equips and inspires people around the world to innovate with data. It is independent, non-profit and non-partisan. It was founded in 2012 by Sir Tim Berners-Lee and Sir Nigel Shadbolt.

The ODI has secured £10m over five years from the UK Government and $4.75m from Omidyar Network, and is working towards long-term sustainability through match funding and direct revenue. The ODI promotes open data's social, environmental and economic benefits via training, research and development and via its growing global network of members, nodes and start-ups.

The ODI Start-up programme has incubated dozens of organisations, helping them generate hundreds of jobs and around £10m in income, generating ten times the return on investment. The ODI equips its start-ups with skills to scale, and connects them with customers and investors. With EU support, the ODI has also developed a €7.8m virtual incubator that can provide €100K equity-free funding to start-ups and SMEs.

The ODI focuses on smart cities as one of its key themes. A number of ODI Start-ups are focused on 'smart cities':

Thingful is a global search engine for the Internet of Things. It maps and indexes dozens of public open data assets and millions of connected devices from temperature sensors to air quality monitors to sharks.

Senseye helps you to use predictive analytics technology using data that machines and equipment already collect, combined with open meteorological data, industry benchmarks and user-generated feedback data.

Pikhaya Smart Streets offers market intelligence to help entrepreneurs and local councils assess the business potential in empty commercial properties in deprived urban centres. The service aggregates open data on local consumer purchasing behaviour and pedestrian footfall, as well as existing local business rent and salary expenditure.

RentSquare is a marketplace where tenants and landlords in the private sector connect directly and exchange contracts around the best rent price.

DataPress – pain-free data portals for smart cities. DataPress is a highly innovative open source data portal that helps local and regional governments to release data, present it in a dashboard, manage transparency commitments and engage with the community.

Start-ups and established organisations often need new skills in order to get value from data. This is why the ODI offers workshops and online training courses to them understand what's possible and learn how to build innovative new products and services. The training covers a range of topics, including data visualisation, data science, business model innovation and smart cities.

CASE STUDY: MAYOR'S EXPORT PROGRAMME

Dinesh Chandegra, Senior Project Officer, Mayor's Export Programme

UK Trade and Industry found that "businesses that export are, on average, 34 per cent more productive, 75 per cent more innovative, undertake three times as much R&D and are 12.5 per cent more resilient than businesses that don't" (Clive Drinkwater, UKTI). We have made it a priority to increase the number of SME exporters in the capital through The Mayor's Export Programme. The programme was a series of international trade missions and export workshops over the course of two years.

Producing innovative smart city and urban solutions is one of the biggest challenges global cities face today. The programme supported over 65 London based smart city focused SMEs with trade missions to New Zealand and Australia, Hong Kong and Macau and Mexico. When overseas, they have been able to showcase how a rapidly growing tech sector can meet London's growth challenge. The missions provided these carefully selected SMEs with valuable access to key contacts, potential investors and partners as well as the opportunity to meet and collaborate with other delegates on each mission.

This exposure to new markets has helped to overcome many of the barriers small businesses face in the UK when considering the potential impacts of exporting. It resulted in over £850,000 of new sales for businesses that took part. Overall, in working closely with UKTI and other partners, the market visits were a powerful export tool. They ensured scientists, investors and collaborators from around the world know how to access London's world-class research, expertise and asset base. In February 2016, London and Partners launched into International Business Programme, offering a new round of support to technology businesses looking to export around the world.

The Mayor of London, Boris Johnson, opening theInternational Business Programme in February 2016

2 Future opportunities

The Smart London Board has made the following recommendations for the next Mayor:

2.1 Innovative businesses taking on London's challenges

The Mayor should:

- Use its convening and regulatory power to bring together sectors to solve common problems, develop open standards, reduce friction in the exchange of data, and create a culture of open innovation. These sector-driven challenges will improve London's data infrastructure, create jobs and give Londoners better services. The challenges might bring together the health and social care sector; public and private providers of transport services; or public sector land holders, civil society, community housing providers and land developers. They will focus on developing a common culture and delivering a shared goal.

- Build on the current circular economy work in the GLA on waste and recycling and address other urban systems including waste and energy. The OPDC is a potential test bed for maximising opportunities for clean tech through circular economy business models.

- Use the Horizon 2020 Lighthouse project, Sharing Cities, as a way of testing new business and funding models instead of a one-off project. It should be an instigator, sustainable and exportable. These models will help businesses understand how best to capture the social, environmental and economic value that can be derived from smart.

- Encourage open innovation in 'smart' solutions across all of London's economy. The early release of transport data created better services for consumers and led to the growth of startups like TransportAPI and CityMapper. CityMapper is now helping people living in cities across the world to receive the same benefits whilst it creates jobs in London to deliver the services. It is time to take the next step and embed this open culture into other sectors to create better services and economic growth.

- Demonstrate how technology can boost housing delivery across the private and public sector using open data, incentives and collaborative business models to increase the sharing of information in the physical planning of London's communities.

- Explore setting up co-location spaces for digital health companies. A digital health incubator and co-working space can bring innovative start-ups and larger companies together to spur collaboration and relationships. The Mayor could advance this idea by convening private sector partners, raising awareness of the needs for and benefits from such as space.

- Create a pathway to market and access to the NHS for smart technologies. The current route to market, and specifically access to the NHS, is challenging for small companies developing innovative solutions and seeking investment.

- Cautiously use telecare to enhance social care. Even though digital technology can provide many benefits to patients and practitioners alike, it is important to balance such solutions with traditional methods. Telecare can compound social isolation and loneliness particularly amongst older recipients.

Londoners and businesses should:

- Explore innovative housing delivery methods, such as high-precision computer controlled pre-fabrication techniques. These can help significantly reduce the unit cost for houses and can serve to design out waste from housing construction, foster local supply chains and support the self-build community as well as offering solutions for traditional house builders.

- Use technology to reduce the amount of downtime during service delivery. For example, connect construction vehicles and logistics vans to a central database to better plan downtime in projects. This will cut the cost and inconvenience of street closures and reduce noise and air pollution.

- Improve telecare solutions, remote care devices that allow the elderly and those with disabilities and mental health problems, to stay at home while receiving professional care. This includes electronic assistive technology devices that collect, store and transmit information to a remote source, usually requiring a particular

type of response. Telehealth devices also relay diagnostic information to clinical staff to support the treatment of long term conditions.

- Promote technologies can help people from diverse cultures and backgrounds monitor their health and communicate with their doctors. Some 42 per cent of Londoners are from Black, Asian, and minority ethnic (BAME) groups, from 90 different ethnic groups and speak 300 languages.

- Explore accessibility apps that can be tailored to those with special needs, for example with hearing problems, slower perception, dementia, visual or impairment. Solutions that support access technology are an opportunity for businesses. The Future Cities Catapult's joint project with Microsoft and Guide Dogs – "Cities Unlocked" is one example.

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[8] NGA is generally taken to mean broadband products that provide a maximum download speed that is greater than 24 megabits per second (Mbit/s). This threshold is commonly considered to be the maximum speed that can be supported on current copper-based networks where BT Openreach is the network operator.

2.2 Smart connected businesses

The Mayor should:

- Raise awareness of market failure in the Central Activities Zone and 'Tech City', such as where SMEs cannot afford to lease dedicated lines and where businesses that have moved to the cloud require symmetric connection speeds. In 2014, with an average download speed of 26.3 Mpbs, London ranked 26th out of 33 European cities in terms of broadband speed, behind Bucharest (81.2 Mbps) and Paris (78.15 Mbps). Between 2009 and 2014, broadband speeds in London increased by 270.3 per cent. This compares to an average 448.7 per cent improvement in speeds in Europe's top ten cities for broadband.

- Provide a more granular understanding of connectivity which recognises speed as only one component in performance metrics

- Enable publicly owned assets to be used for wireless and mobile communications. Examples of proposals from industry include installing small cells and street furniture in high density urban areas or larger masts in suburban areas with topography and business case challenges.

- Acknowledge connectivity as the 'fourth' utility and lobby for a regulatory framework to support this. The benefits of faster, more resilient connectivity remain unknown to too many businesses. The Mayor should raise awareness of the business benefits to help stimulate demand for reliable and affordable services.

- Set up pop-up technology accelerators where social, economic, and/or environmental opportunities and challenges are not being met by the market.

- Argue at national and European levels that there are still too many areas of London where Next Generation Access (NGA) broadband is not available. Regulatory and financial intervention may be necessary as SMEs are more likely to depend on NGA than on other, more expensive, connectivity solutions.

- Work more closely with and support borough initiatives so that all boroughs can benefit from good ideas and good practice in the capital, and help scale up innovation.

- The London Plan should include a clear commitment to promote strategic investment in connectivity infrastructure.

Londoners and businesses should:

- Work with innovators to help design smart technology that will future-proof new developments and support behaviour change

- Ensure clearer information and guidance are available to businesses from telecoms providers on the full range of connectivity options.

- Lobby Government to introduce a requirement to install 'super-fast' connectivity infrastructure for new developments

2.3 Jobs and growth

The Mayor should:

- Enhance understanding of the role and levers of the Mayor in supporting tech business growth

- Invest in more international cooperation programmes with other global tech hot-spots, such as Silicon Valley

- Work with boroughs to engage with SMEs to enable more rapid scale-up

- Be a 'smarter customer' of smart - be clear about the standards, regulation, legal and procurement considerations around smart solutions

- Adopt a set of open standards which allows the full range of suppliers to engage (for example London Datastore is built on open standards, Hypercat is another such standard – enabling the Internet of Things) and which avoids being tied to one particular vendor or supplier.

Londoners and businesses should:

- Work with City Hall to build a culture of mentoring, support, and funding for start-ups and scale-ups.

- Work with Business Improvement Districts to take a smart approach to solving business challenges

- Scale up approaches such as Cognicity's challenge programme that operates across six categories from resource management in buildings to integrated transport now being piloted by start-ups across the Canary Wharf estate

London's population challenge of over 10 million people in 2036

THE FUTURE OF SMART IN LONDON

The capital needs an approach to data and technology that focuses on the needs of Londoners and businesses in a fast-growing city. The Mayor's role is to engage Londoners and businesses in co-designing the capital's future growth solutions through providing the infrastructure, data, skills, capacity, and opportunities for collaboration.

Challenges for London in data and technology are never static. In this section, the Smart London Board sets out the strategic actions required to meet tomorrow's challenges and opportunities. Hard work will be needed to maintain London's position as a global leader in the tech sector and to use that strength to help the city better cope with future growth trends.

The Board sets out its priorities for the future as:

ENGAGING OUR CITIZENS

- *Priority 1: Wide, inclusive digital engagement with Londoners and businesses*

ENABLING GOOD GROWTH

- *Priority 2: Leadership*
- *Priority 3: Resilient infrastructure*
- *Priority 4: The housing challenge*
- *Priority 5: Strengthening London's data infrastructure*
- *Priority 6: Investing in innovation*

WORKING WITH BUSINESS

- *Priority 7: Breaking boundaries*
- *Priority 8: Scaling up innovation*
- *Priority 9: Connectivity*

1 Engaging our citizens

Priority 1: Wide, inclusive digital engagement with Londoners and businesses

- Citizen engagement in the development of digital services should be part of the democratic process. Londoners and businesses should become 'digitally included' and both the public and private sector need to scale-up proven efforts to overcome digital exclusion.

- The Mayor should work with the London Resilience Partnership to innovate with new ways to communicate with Londoners during and after emergencies, for example testing network theory, analysing social media, and picture and video communication.

- The Mayor should support the tech community to engage citizens and enable more co-design between developers, citizen and business groups to ensure smart innovation meets user need. The tech community should also partner with digital skills providers to share the lessons of co-design from public sector-funded projects.

- London's governments should use technology more for impact assessments of policies and programmes. Recent advances, from dashboards to harvesting social media, are powerful and active ways to gather information from Londoners and businesses about the effectiveness of policies and programmes that affect them.

2 Enabling good growth

Priority 2: Leadership

- For the new Mayor, this board stands ready to produce the Smart London Plan and/or strategic Technology Plan the capital now needs alongside the new City Data Strategy. These plans will define the GLA's leadership structure around data and technology and set out what works best for the two-tierstructure of London government.

- The Board recommends the GLA appoints a Chief Digital Officer to enhance city leadership in data and technology.

- The Board should develop a stronger leadership and convening function for London, and hold London's government to account. For example,

  1. The Board should make recommendations on data governance, and what programme designs and regulations will join up different silos

  and;

  2. The Board should carry out a comprehensive assessment of the digital technologies that are used across all industries. Working with stakeholders (such as London First, Tech London Advocates and the Chamber of Commerce) this should be used to promote the digital skills the sector needs to grow, from start-ups to established firms.

Priority 3: Resilient infrastructure

- Connected social, economic, and environmental infrastructure is needed to meet increasing demand for energy, waste, water, transport, health services etc.. London's service providers should share their resource flows and investment plans with the Mayor and with each other. IMA LDN is one way utility providers can currently do this.

- Operators are building the infrastructure that the regulations allow, but not the infrastructure that is most appropriate to meet consumers' fixed and mobile broadband coverage demands. The London Plan should include a clear commitment to promote strategic investment in connectivity infrastructure.

- The development of London's opportunity areas are limited by the level of public transport connectivity that can be achieved using existing infrastructure and through building traditional modes of public transport. The Mayor should promote investment in new transport ideas - from next generation smart car share schemes and automated personal rapid transit systems to adaptive public transport route planning.

Priority 4: The housing challenge

• The Smart London Plan for the new Mayor should specifically lever the potential for smart to address London's housing challenge.

• Boroughs and Transport for London should make greater use of real-time environmental sensors in London's streets and spaces to measure factors such as air quality, street level temperature, wind speed and noise levels to realise and maintain higher quality place making standards.

• Housing developers and providers should experiment with housing delivery methods that make better use of data to reduce the unit cost for houses, design out waste from housing construction, foster local supply chains and support traditional house-builders and the self-build community.

• The Mayor should consider including connected appliances and digital services in housing design standards to enable people living with disabilities and the elderly to remain in their own homes, living independently for longer.

Priority 5: Strengthening London's data infrastructure

• London should think of data as infrastructure to underpin transparency, accountability, public services, business innovation and civil society. Data such as statistics, maps and real-time sensor readings help city governments to make decisions, build services and gain insight. London needs to get more value from data to enable its Victorian physical infrastructure to meet the 21st century's needs.

• The Mayor should promote the city's role as a data platform to showcase how City Hall will use data for the benefit of Londoners to increase trust and transparency.

• London is already a world leader in using data and encouraging open innovation. The early release of transport data created better services for consumers and led to the growth of startups like TransportAPI and CityMapper. It is time to take the next step and embed this open culture into other sectors to create better services and economic growth.

• The Mayor's convening and regulatory power should bring together stakeholders from across different sectors to improve London's data infrastructure, design and deliver better services for Londoners.

• The Mayor should improve data literacy and data protection for citizens, businesses and the public sector. It is crucial that governments protect data that needs to be kept private, just as it is crucial that they openly publish data that can be open for everyone to use. Both privacy and openness help create trust.

Priority 6: Investing in innovation

- The Mayor should create an innovation investment programme that supports scalable smart environmental solutions and services as market opportunities for the technology and data sector.

- London's government should explore the power of the crowd to source and finance ideas to solve the capital's infrastructure challenges and test new ways of designing infrastructure before it is needed. IMA LDN should help stimulate this innovative approach.

- Transport for London and the London boroughs should increase their use of digital tools to renew London's transport infrastructure and minimise transport disruption. For example, scaling-up solutions being piloted by TfL and the boroughs via TfL's Innovation Fund and Future Streets Incubator Fund are an opportunity for both the public and private sector.

3 Working with business

Priority 7: Breaking boundaries

- The Smart London Board should promote more new business and partnership models so those interested in smart cities can look outside of their silos. The Mayor should take advantage of City Hall's 'Sharing Cities' programme to understand, develop and trial business, investment and governance models, essential for aggregation and replication of smart city solutions to make transformative improvements, and enhance sustainability.

- The Mayor should promote the adoption a set of open standards which allows the full range of suppliers to engage and which avoids becoming tied to one particular vendor or supplier. The London Datastore is built on open standards and Hypercat is another such standard designed for the Internet of Things.

- The Mayor should question regulation if it prevents innovation from targeting previously overlooked markets or from starting new ones. Two examples in need of attention are the various business models that fall under the sharing economy and the circular economy.

Priority 8: Scaling up innovation

- The Mayor should convene all parties and pilot innovative solutions to resolve 'real world' challenges that affect London and Londoners. It should pave the way for solutions to scale-up from pilots to wide distribution by connecting with and supporting London's expanding community of tech entrepreneurs. City Hall should catalyse London's leading tech and creative firms to scale up digital solutions to housing, transport, health, social care, and policing challenges.

- The Mayor should convene boroughs, their elected leaders and cabinet members to build a network of local leaders in 'smart' to drive the development and implementation of smart technology across London.

- City Hall and the boroughs should use the levers available to them to scale-up SMEs that are meeting London's challenges. They should make market opportunities more accessible to innovative SMEs through collaborative research and development. City Hall should establish open data standards across London's industries and governments which even the playing field for SMEs when they apply to become a supplier to the public, private or third sectors.

Priority 9: Connectivity

- The Smart London Board believes connectivity is essential for all Londoners and businesses. Some small businesses in Central London still cannot get adequate connectivity from the basic fixed and mobile broadband networks. The Mayor should campaign to improve basic broadband networks and support alternative connectivity providers to prevent small companies from paying for expensive bespoke digital solutions.

- The Mayor should support a more diverse supply of broadband providers. Such connectivity interventions must be targeted at schemes that encourage greater demand aggregation and encourage diversification and innovation in supply.

- The Mayor should call for broadband to be designated as the 'fourth' utility, with a supporting regulatory and planning framework.

THE SMART LONDON BOARD

The Smart London Board is the Mayor's top line-up of experts – including leading academics, businesses and entrepreneurs – to advise on how London can put digital technology at the heart of making the capital an even better place to live, work and invest.

The Chair of the board is Professor David Gann CBE, Vice President (Development and Innovation), Imperial College London.

The members of the board are:

Julie Alexander, Director of Urban Development, Siemens

Chris Bilton, Director of Research and Technology at BT

Volker Buscher, Director at Arup

Andrew Carr, COO of Digital Catapult

Professor Dr Martin G. Curley, Vice President of Intel Corporation

Kru Desai, UK Head of Government and Infrastructure at KPMG

Rupert Green, Smart Design Lead at Parsons Brinckerhoff

Gerard Grech, CEO of Tech City UK

Professor Andy Hudson-Smith, Director and Deputy Chair of the Centre for Advanced Spatial Analysis (CASA) at The Bartlett, University College London

Gordon Luo, CEO of Huawei UK

Peter Madden, CEO of Future Cities Catapult

Alwin Magimay, Head of Digital and Analytics at KPMG UK

Dennis Moynihan, Director of the London Node of EIT ICT Labs

Professor John Polak, Professor of Transport Demand and Head of the Centre for Transport Studies at Imperial College London.

Dr Mike Short, Vice President at Telefonica Europe

Ian Short, Interim CEO of Climate-KIC

Gavin Starks, CEO of Open Data Institute.

Mike Steep, Senior Vice President of Global Business Operations, PARC

Mukhtiar Tanda, Partner Real Estate and Urban Development at Berwin Leighton Paisner

Paula White, Software Client Architect at IBM

Dr Tim Whitley, Managing Director of Research and Innovation at BT

Jim Wood, Director of IT and Information Services, London Legacy Development Corporation

GLOSSARY

- **4G:** The current mobile communications standard that allows mobile phones, computers, and other portable electronic devices to access the internet wirelessly.

- **5G:** A mobile communications standard intended to replace 4G, allowing wireless Internet access at a much higher speed.

- **Big Data:** Big data involves very large datasets, such as billions of tweets or terabytes of sensor data.

- **BIM:** Building Information Modelling uses multi-level data rendered in a 3D common language environment. This allows the interdisciplinary parties in the project – architects, structural engineers, mechanical and electrical engineers, designers and manufacturers – to talk about exactly the same thing and, crucially for so many participants, visualise it in 3D.

- **Bluetooth:** A standard for the short-range wireless interconnection of mobile phones, computers, and other electronic devices.

- **Care Connect:** An NHS England innovation modelled on the highly successful 311 in the USA which has transformed the relationship between citizens and their public services. Interactive maps and dashboards enable the public to track progress and openly see how NHS providers are responding.

- **CCTV:** Closed-circuit television used for security monitoring.

- **CELSIUS Project:** Smart district heating and cooling solutions. This project is playing a key role in London's smart city evolution and its development as a low carbon, resource efficient city that uses the available waste heat generated through its day-to-day operation. It will inform London's medium to long-term strategic approach to energy system and network development to ensure London has the resilient, low carbon and cost effective energy infrastructure required to support a highly competitive, and growing, global city.

- **Cloud Computing/The Cloud:** The practice of using a network of remote servers hosted on the internet to store, manage, and process data, rather than a local server or a personal computer.

- **Coding:** Coding, or programming, commonly refers to computer programming, which is the process of writing software, applications and websites, which are all created using a programming language. There are many different programming languages, and programmers often tend to specialise in one or two. Examples include python, ruby, and java.

- **Digital Catapult:** One of seven 'Catapults' launched by the UK's Technology Strategy Board as a network of world-leading centres designed to transform the UK's capability for innovation in seven specific areas and help drive future economic growth. The Digital Catapult focusses on accelerating growth through the Digital Economy.

- **CoSy:** A Cooperative system, looks to examine the potential for using existing types of technologies, such as mobile phones, GPS, satnav, bluetooth, twitter, Cloud computing etc, to help develop an understanding of the transport network in real time.

- **Crossrail:** The new high frequency, high capacity railway for London and the South East. When Crossrail opens in 2018 it will, for the first time, produce a direct connection between all of London's main business centres, linking Heathrow, with Paddington, the West End, the City and Canary Wharf.

- **E-commerce:** Commercial transactions conducted electronically on the Internet.

- **Future Cities Catapult:** One of seven 'Catapults' launched by the UK's Technology Strategy Board as a network of world-leading centres designed to transform the UK's capability for innovation in seven specific areas and help drive future economic growth. The Future Cities Catapult focusses on Urban Innovation: how cities can take a more joined-up approach to the way they plan and operate. To improve quality of life, strengthen their economy and protect the environment.

- **GPS:** Global Positioning System, an accurate worldwide navigational and surveying facility based on the reception of signals from an array of orbiting satellite.

- **Here East:** A new digital quarter for London that will support the growth of the digital and creative industries. Situated on Queen Elizabeth Olympic Park and in the heart of East London's creative scene, iCITY will be a world-leading centre of innovation, education and enterprise.

- **Legible London:** A pedestrian way finding system that helps people walk around the capital.

- **LFB:** London Fire Brigade is the body responsible for London's fire and rescue service. It is the busiest in the country and one of the largest firefighting and rescue organisations in the world.

- **LLDC:** London Legacy Development Corporation is a Mayoral Development Corporation responsible for the regeneration legacy from the London 2012 Games, created in April 2012. Its role is to promote and deliver physical, social, economic and environmental regeneration of the Olympic Park and its surrounding area, in particular by maximising the legacy of the 2012 Olympic and Paralympic Games, by securing high-quality sustainable development and investment, ensuring the long-term success of the facilities and assets within its direct control, and supporting the aim of convergence.

- **London and Partners:** The Mayor's promotional organisation for London, leads on attracting inward investment into, and overseas promotion of, London's tech economy. London & Partners took over responsibility for attracting foreign investment into London's tech economy from Tech City UK on April 1 2014.

- **London Dashboard:** A 'dashboard' display of data covering a range of topics, updated at regular and frequent intervals which helps put the figure from datasets in context, more detailed analysis sits beyond the headline figures.

- **London Datastore:** Created by the GLA as an innovation towards freeing London's data, the datastore provides free access to a number of data-sets. The GLA is committed to influencing and cajoling other public sector organisations into releasing their data onto the site providing an easily accessible location for multiple data sets.

- **London Development Database:** The London Development Database records selected planning permissions in the Greater London area as part of the process of monitoring the Mayor's London Plan. These are tracked through to implementation, allowing us to produce data on completions and the development pipeline in addition to levels of approvals. The LDD is a collaboration between the GLA, which provides the IT infrastructure and co-ordinates the project, and the London boroughs who are responsible for providing the data for schemes in their area.

- **London Enterprise Panel:** The local enterprise partnership for London. Chaired by Mayor of London Boris Johnson, the LEP is the body through which the Mayoralty works with London's boroughs, business and Transport for London to take a strategic view of the regeneration, employment and skills agenda for London.

- **London Green Fund:** A £100 million fund set up to invest in schemes that will cut London's carbon emission. The fund was launched in October 2009 by the Mayor of London and the European Commissioner for Regional Policy - the first JESSICA Holding fund in the UK.

- **London Schools Excellence Funding:** The fund is part of the Mayor's Education Programme and will, alongside the London Schools Gold Club and London Curriculum boost standards in the capital's schools by helping students achieve better results through expert teaching, improved subject knowledge and subject specific learning methods.

- **Mayor's 2020 Vision:** The 2020 Vision sets a broad course that communicates London's readiness and ambition, and our city's ability to meet the connected challenges of rapid population growth and economic success.

- **Mayor's Long Term Infrastructure Investment Plan:** The Infrastructure Investment Plan will be as much a capital investment plan as an infrastructure plan. It will provide a high level assessment of London's infrastructure needs; along with an assessment of the magnitude of costs associated with the required infrastructure. Importantly, it will also consider funding streams, both in a future where the current fiscal arrangements apply and in a more fiscally devolved future. The plan aims to be published in Summer 2014.

- **Mayor's Opportunity Areas:** Opportunity Areas are London's major source of brownfield land with significant capacity for new housing, commercial and other development linked to existing or potential improvements to public transport accessibility. Typically they can accommodate at least 5,000 jobs or 2,500 new homes or a combination of the two, along with other supporting facilities and infrastructure. 33 were identified as part of the Mayor's draft London plan.

- **MedCity:** 'MedCity' promotes a joined up and globally distinctive life sciences offer for London and the Greater South East (GSE); acts as a visible 'go to' point for businesses and investors, whether global or local, to access, invest in or collaborate with London and the GSE's science base; and provides a strong voice for the sector, champion its strengths, but also raise awareness of the factors impeding further growth to catalyse positive change. MedCity will help London and the Greater South East to be the world's greatest life science hub.

- **MPS:** Metropolitan Police Service is police force responsible for the whole of Greater London apart from the City of London which is the responsibility of the City of London Police.

- **Open Data:** Open data is information that is available for anyone to use, for any purpose, at no cost. The Open Definition sets out a number of principles for Open Data.

- **Open Definition:** A piece of data or content is open if anyone is free to use, reuse, and redistribute it - subject only, at most, to the requirement to attribute and/or share-alike.

- **Oyster:** A plastic smartcard that can be used on London's public transport instead of paper tickets. Travelcards, Bus & Tram season tickets and pay as you go credit can be loaded onto it.

- **Queen Elizabeth Olympic Park:** Queen Elizabeth Olympic Park is the site that hosted the 2012 Olympic Games. The site and its surrounds are now being developed and regenerated by the London Legacy Development Corporation, building on the 2012 Olympic and Paralympic Games legacy.

- **SatNav:** Navigation dependent on information received from satellites

- **SCOOT:** Split Cycle Offset Optimisation Technique is an adaptive traffic control system. It coordinates the operation of all the traffic signals in an area to give good progression to vehicles through the network. Whilst coordinating all the signals, it responds intelligently and continuously as traffic flow changes and fluctuates throughout the day. It removes the dependence of less sophisticated systems on signal plans, which have to be expensively updated.

- **Smart City:** The general term used to discuss how cities across the globe are sharing information and making use of technology to work more efficiently.

- **Smart Grid Services:** A utility supply network that uses digital communications technology to detect and react to local changes in usage.

- **Smart London:** Smart London is about how the capital as a whole functions as a result of the interplay between its 'systems' – from local labour markets to financial markets, from local government to education, healthcare, transportation and utilities. Smart London is where the linkages between these different systems are better understood, where digital technology is used to better integrate these different systems, and London as a whole works more efficiently as a result - for the benefit of its inhabitants and visitors.

- **SME:** Small to medium-sized enterprise, a company with no more than 250 employees.

- **Talk London:** Talk London hosts online discussions, polls, live Q&A events, surveys and focus groups - discussing a wide range of topics from improving standards in the private rented sector to cyclist safety around HGVs (heavy goods vehicles). Through the community, Londoners are taking part in policy conversations to generate new ideas. We can also consult Londoners on our ideas to make sure that policies are responsive, effective and resonate with communities.

- **Team London:** The Mayor's volunteering programme for London, Team London makes it quick and easy for Londoners to give their time, find volunteer opportunities and do great things for their city.

- **Tech City:** Also known as Silicon Roundabout. A number of digital and creative small to medium start-up companies have established themselves around the Old Street roundabout and Shoreditch areas. In just three years, the originally small cluster of high-tech firms around the Old Street roundabout has become the capital's leading hub for digital, creative and high-technology companies.

- **Tech City UK:** Tech City UK is a publicly supported non-profit organisation launched in Shoreditch in 2010 to support the east London tech cluster. In April 2014, they handed over promotion of London's tech sector to London & Partners to take on a national role, but still promotes the London tech sector as part of their work to promote the tech sector of the UK.

- **TfL:** Transport for London is the local government body responsible for the majority of the transport system in Greater London.

- **Twitter:** Social networking and microblogging service utilising instant messaging, SMS or a web interface.

- **Ultrafast Broadband:** Broadband service with downloading speeds of at least 100Mbps and uploading speeds of at least 50Mbps. This is most often delivered by fibre to the premises (FTTP).

- **Wifi:** A facility allowing computers, smartphones, or other devices to connect to the internet or communicate with one another wirelessly within a particular area.

- **Wifi Hotspot:** A public place where a wireless signal is made available so that the internet can be accessed.