SHARINGCITIES

Smart Street Infrastructure:
Strategic assets for a true Smart City

A SHARING CITIES PLAYBOOK

2020 V.1

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This playbook is produced by Sharing Cities, a major international smart cities project. It addresses some of the most pressing urban challenges cities face today across ten replicable solutions.

WHAT IS THIS PLAYBOOK?

This guide provides an overview of how each Sharing Cities' lighthouse city – Lisbon, London, and Milan created a true smart city by fusing raw data from smart devices and sensors with an Urban Data Platform to create smart data and insights enabling the cities to make better decisions and improve services.

This playbook will:

- Help you understand what solutions were tested in our Sharing Cities lighthouse cities and what urban challenges they address.
- Help you understand the value proposition of the solution, in economic, social, environmental, and financial terms.
- Offer practical guidance so city officers have all the information they need to rollout out the solutions in their city, including:
  - Strategic and technical design.
  - Business models and financing.
  - Stakeholder engagement and communications.
  - How to safeguard citizen interests.
- Answer common questions and concerns you may have about these solutions.
- Sum up the key challenges, recommendations, and lessons learned from testing these solutions. Other cities can then use these insights to guide their own schemes.

TOOLS & RESOURCES

The playbook also includes references to a range of tools to support your development and delivery plans. If you'd like the source files for these tools, email: Sharing Cities **pmo@sharingcities.eu** or tweet us **@CitiesSharing**

WHO IS THIS GUIDE FOR?

We created this guide with two key audiences in mind:

1

City leaders, governments and public authorities who are considering or are in the initial stages of rolling out smart street infrastructure and Internet of Things (IoT) technology. They want to understand the opportunities, business models and governance choices that exist around such a framework.

2

Lighthouse city members of Sharing Cities looking for a way to sustain their Smart technology, such as smart lampposts, post-funding from Horizon 2020.

3

Follower cities in the Sharing Cities network who may be in the process of developing and rolling out smart street infrastructure and IoT technology.

4

Industry stakeholders, regulators, policymakers and end users that may gain useful insights into new ways of working and governance practices.

LIGHTHOUSE CITIES

LISBON

LONDON

MILAN

SHARING CITIES: A TESTING GROUND FOR INNOVATION

Sharing Cities aims to change forever how we think about the role of digital technology in our cities. We want to clarify how we all can benefit from and contribute to this transformation process.

Led by the Greater London Authority, we have run 10 smart city projects in each of our lighthouse cities of Lisbon, Milan, and London (with the Royal Borough of Greenwich). Our aim is to test how innovative technological solutions can address some of the most pressing urban challenges cities face. These include in mobility, energy efficiency, data management, and citizen engagement.

Our vision is of a more agile and more collaborative smart cities market. This would dramatically increase both the speed and scale at which we can rollout smart solutions across European cities. We wish to engage citizens in new ways too, so they can play an active role in transforming their communities. We want to share solutions, practices, experiences and results, and improve the way we manage city data and infrastructure. By doing so, we will co-create a better living environment and reduce our energy costs.

About Sharing Cities

The Sharing Cities 'lighthouse' project is a testbed for finding better, common approaches to making smart cities a reality. By fostering international collaboration between industry and cities, it will develop affordable, integrated, commercial-scale smart city solutions with high market potential. Project partners also work closely with the European Innovation Partnership on Smart Cities and Communities (EIP SCC01 – Lighthouse Projects).

In addition, Sharing Cities offers a framework for citizen engagement and collaboration at a local level. This strengthens trust between cities and communities. The project draws on €24m in EU funding. It aims to trigger €500m in investment and have a long-term impact on the smart cities' marketplace.

Part of the European Horizon 2020 programme, Sharing Cities includes 34 European partners from across the private, public and academic sectors. Together the group works to deliver near-to-market solutions, such as:

- **Smart lampposts** – integrated smart lighting with other smart service infrastructures (electric vehicle, EV, charging; smart parking; traffic sensing; flow data; wifi etc).
- **Shared e-mobility** – a portfolio of linked initiatives supporting the shift to low carbon shared mobility solutions. Specifically: EV car-sharing; e-bikes; EV charging; smart parking; e-logistics.
- **Sustainable energy management systems** – rollout system to integrate and optimise energy from all sources in areas of cities (and interface with the city-wide system). This includes demand response measures.
- **Urban sharing platform (USP)** – a way to manage data from a wide range of sources including both sensors and traditional statistics. The platform uses common principles, open technologies and standards.

- **Digital social market (DSM)** – an approach to encourage citizens to engage with and use sustainable smart city services. The aim is to shift perceptions and change behaviours through rewards in exchange for continued and improved citizen engagement.
- **Building retrofit** – install energy efficient measures in existing public, social, and private building stock. This will link to other solutions like the integrated energy management system to optimise energy performance.

Packaging tested smart city solutions across Europe

Sharing Cities has captured the experiences from deploying these solutions and lessons learned along the way in a series of playbooks. Our programme partners and other cities can use this research to reduce barriers, speed up processes and ensure a consistent approach.

We want to provide a set of 'packaged' smart city solutions and document the replicable parts of a smart city solution. This will help cities and suppliers better navigate the challenges of delivering fresh, cross-sectoral solutions to improve the urban environment. Making these solutions both cheaper and quicker to come to market will boost the confidence of buyers and investors alike.

Our playbooks use the EU Smart Cities Cluster's emerging 'packaging concept'. This captures (i) societal needs (ii) technical components (iii) business models and financing options. This one is concerned withsmart street infrastrucure To find out more about the EU Smart Cities Clusters projects, visit the Smart Cities Marketplace.

1. Smart street infrastructure: What is it?

The Cambridge Centre for Smart Infrastructure and Construction defines smart infrastructure as the result of combining physical infrastructure with digital infrastructure, providing improved information to enable better decision making, faster and cheaper.[1] This is largely achieved by collecting and combining raw data from the cities 'things' or assets, often in real-time, to create new smarter data. This in turn creates new insights which provide new services, efficiencies and value for cities. Smart street infrastructure and the sensor technologies which fundamentally enable it are under the umbrella of Internet of Things (IoT) technology. The cities IoT encompasses both existing infrastructure such as roads, signposts, public transport and new smart infrastructure such as air quality monitors, shared EV's, advanced heating & building controls and smart lampposts.

The Mayor of London's Smarter London Together Roadmap defines a Smart City as, "a collaborative, connected and responsive city".[2] A Smart City integrates digital technologies and uses city-wide data to respond to citizens' needs.

Smart infrastructure allows owners and operators to get more out of their assets and provide additional services to citizens, or to reduce consumption of resources and achieve cost savings. Assets that can be considered "smart" include smart lampposts, roads, micro-mobility (eg. e-bike or e-scooter schemes) buildings, local and distributed energy systems, and electric vehicle charging infrastructure. All these assets produce data that can be fed into data platforms which support better decision making and/or the optimisation of energy use so that it can reduce emissions, increase cost savings, and a range of other outcomes.

At its core, smart street infrastructure involves sensor technology on a physical asset with data being transferred from the asset to some type of data platform, which allows the owners and operators of these assets to understand how these assets are being used by citizens, and allows them to make manage these assets more optimally to realise savings, carbon reductions, improve health and wellbeing. **This infrastructure underpins the concept of being a 'smart city'**.

In Sharing Cities, the smart street infrastructure we implemented includes:

- Smart lampposts and street furniture.
- Sensor networks.
- Urban data platforms.
- Electric-based transport networks and infrastructure, including e-bike sharing schemes and electric vehicle charging networks.
- Sustainable energy management systems.

Smart street infrastructure generates data that is useful to city managers at all levels. When this data comes together in one place, for example in a data platform, it can become a powerful tool for city planners. This playbook draws together a complex range of sensors and data types with data integration which enables cities to manage the whole city infrastructure.

Key components of Sharing Cities' smart street infrastructure

COLLECTION OF DATA FROM INDIVIDUAL ASSETS AND TECHNOLOGIES

INTEGRATING DATASETS VIA URBAN SHARING PLATFORM

INFORMED DECISION-MAKING FACILITATED THROUGH SHARED PLATFORMS, DRIVING DECISIONS ON TECH & ROLLOUT

Sharing Cities tested a range of technologies across various sectors, including mobility, data platforms, infrastructure, and energy systems. Many of these technologies complement each other. Some even directly work together to produce better results. This table shows how different Sharing Cities technologies relate. You may find it useful to cross reference materials in other playbooks, which can be found on the Sharing Cities website.

RELATED TECHNOLOGIES TESTED IN SHARING CITIES

	e-Bikes Sharing Schemes	e-Car Sharing	e-Vehicle Chargers	e-Logistics	Smart Parking	Digital Social Market	Building Retrofit	Sustainable Energy Management Systems	Smart Lampposts	Data Platforms
e-Bikes Sharing Schemes	✗		✓			✓				
e-Car Sharing		✗	✓			✓	✓		✓	✓
e-Vehicle Chargers	✓	✓	✗	✓	✓		✓	✓	✓	✓
e-Logistics			✓	✗	✓					✓
Smart Parking		✓	✓		✗					✓
Digital Social Market	✓	✓				✗	✓	✓		
Building Retrofit		✓	✓			✓	✗	✓		
Sustainable Energy Management Systems			✓				✓	✗		✓
Smart Lampposts			✓						✗	✓
Data Platforms	✓	✓	✓	✓				✓	✓	✗

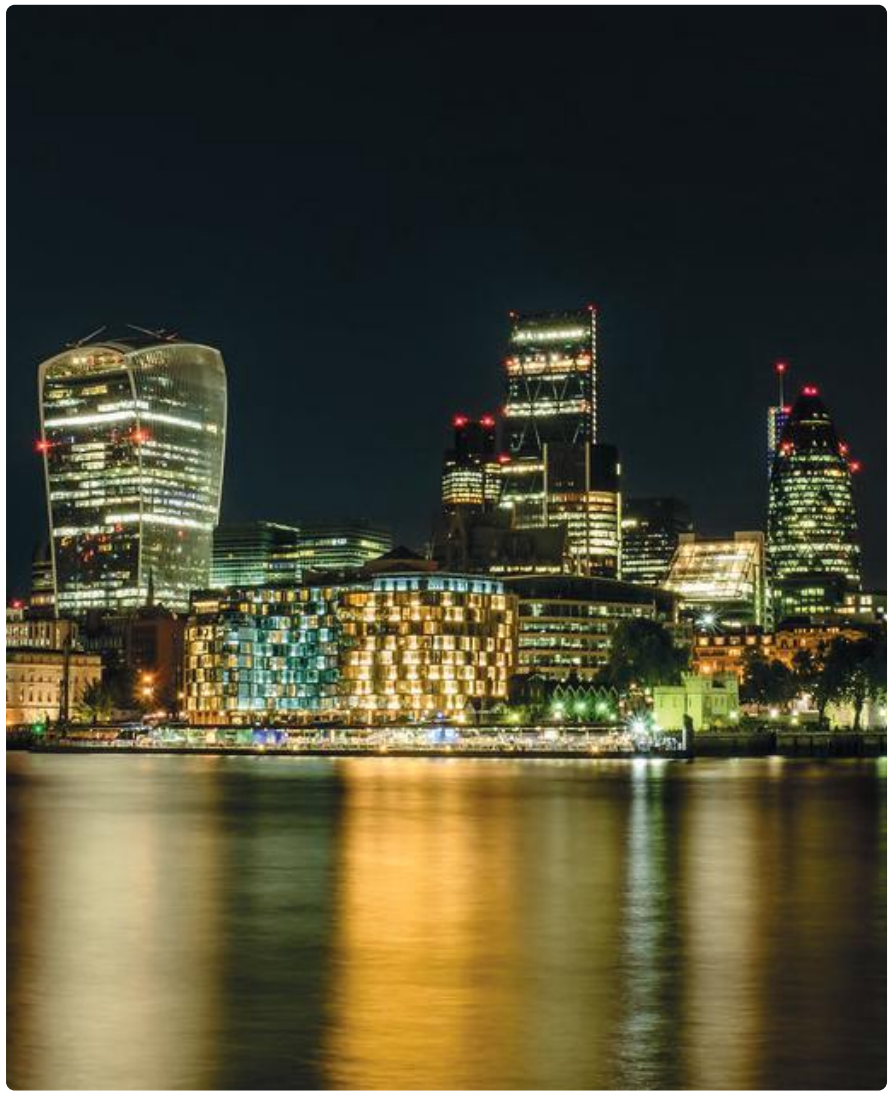
2. The challenge

Like any form of innovation, adoption of smart infrastructure is slow and needs to be managed carefully. There are varying levels of adoption of this kind of technology depending on your location, the capacity of local leaders and officers, the strength of the local marketplace and the type of technology being deployed. This means that the marketplace in general is very patchy, at a local, national and European level. There are a range of differing definitions and concepts of what smart street infrastructure is and how it can be used, and it is often classed as innovation, which is seen as risky to finance. However, through the Sharing Cities programme we have seen that cities are eager to improve their application of smart technology and collaborate with others to create long lasting solutions.

There are other barriers to the adoption of smart infrastructure that include:

- **Cross cutting nature of smart infrastructure** – this technology does not sit neatly within one municipality or government department but cuts across them all. This means that ownership can be a challenge.
- **The Smart cities market is still too solution focused** – across Europe there is a need to bridge the gap between the demand side (cities) and the supply side. The solutions that are created need to be more focused on the needs of the city and the city in turn needs to improve the ways in which it expresses its needs to the market. By addressing this mismatch, we can better incentivise suppliers to provide what is needed and encourage more diversity in the marketplace. Cities can accelerate this by defining their 'Use Cases' – descriptions of how and why they see a value or 'use' of smart infrastructure. These Use Cases will be common to many cities so by sharing experiences this process can be accelerated. Some examples are provided later in this document.
- **Investment is a challenge** – investment in innovative smart street infrastructure is patchy and often focused on specific solutions, not city outcomes. There are a lack of proven business models that would give assurance to private investors and it is difficult to demonstrate a return on investment for technology that is often less than five years old.
- **Interaction with private smart infrastructure is limited** – while city authorities will be responsible for deploying the more visible smart infrastructure on the street, much of the smart infrastructure in a city will be privately owned, such as CCTV and WiFi. Depending on how these assets are managed, the municipality may have little control or oversight of this technology and its uses.
- **Interoperability between different systems** – a barrier to realise the full impact of big data and a truly interconnected city the challenge of interoperability between the various systems and platforms that exist within that city. This challenge is amplified in large, fragmented cities such as London with multiple layers of public sector agencies.

- **Public perception can be negative** – in many places the positive case for smart infrastructure is not packaged and communicated effectively, and so false information is allowed to thrive. A good example of this is a conspiracy theory that '5G causes COVID-19', but even at a less extreme end of the spectrum many people associate smart technology with surveillance culture and an invasion of privacy. More open and honest discussions between municipalities and citizens is the key to building public support, to help the public understand the value the services, improvements and benefits that smart infrastructure can enable.
- **Ethics and transparency** – in order to ensure the technology that cities deploy doesn't impinge on people's privacy, or cause further inequalities in society, we need to ensure that technology is commissioned ethically and deliver smart infrastructure in a transparent and responsible way. This is particularly important when it comes to data collection and the use of data. Strong governance and clear guidelines are needed in order to address these challenges at the commissioning stage.
- **Cyber security awareness** – while most officers will be aware of what cyber security is and some of the problems it can cause, an understanding of how to address cyber security when commissioning smart infrastructure is still low, and knowledge often sits solely in teams or individuals, like CISOs, with direct responsibility over technology. Government guidance in this area is improvement, but it still complex. A more targeted approach to this challenge is needed, which includes cyber-secure principles set by national governments and the use of pre-vetting at the procurement stage.



3. A strategic approach to smart street infrastructure

One of the ways to address the challenges outlined in *Section 2* is for a city to take a strategic and whole-system approach to implementing smart infrastructure. This involves understanding better how technology can help to solve some of a city's needs and contribute to the municipalities' outcomes. This approach opens the city up to outcomes-based procurement, human centred design and learning and collaboration with other cities.

The goal should be for the city to support its commissioners to commission smart infrastructure with more confidence by setting a common framework in which they can find support and guidance. A common approach can reduce siloed commissioning, streamline procurement, ensure interoperability and create a more vibrant marketplace.

A smart city strategy should not be focused on increasing the amount of smart infrastructure installed, but ensuring that any smart infrastructure commissioned is done in the right way with the right technology.

The benefits of smart infrastructure are real and have been proven.

These include:

- Improved services and outcomes for citizens through more efficient infrastructure, data driven service (re)design and more connected places.
- Enable municipalities to remotely manage their assets making them more efficient and responsive and realise revenue savings as a result.
- Facilitate the decarbonisation of cities and related goals to reach net-zero. Cities will only reach their ambitious carbon reduction targets if they use technology to decarbonise transport and energy systems, and existing building stock.
- Smart infrastructures provide cities with rich data that can be used to improve outcomes for citizens and is vital to data platforms of the future, including digital twins.
- Increase the connectivity of a city, which is already becoming a reality, through the adoption of technologies such as 5G, and policies such as universal broadband and public WiFi.
- Help cities respond to a specific need or emergency (such as - flooding, congestion, pandemic, etc.)
- It is increasingly part of standard service delivery, a part of a contract that needs to be considered, rather than a service area in its own right.

As a result of these benefits, if a city can foster a common approach to smart infrastructure then it can result in the following outcomes:

- Ensures all citizens experience the economic, social and environmental benefits that new and innovative technology can bring.
- Takes advantage of a cities scale.
- Accelerates the adoption of proven technology through common standards and procurement.
- Helps create a more city-needs led marketplace.

Key considerations

There are several merits to employing smart infrastructure, as well as challenges and contextual considerations that impact the viability and effectiveness of it in order to achieve your goals. This section highlights some of the key learnings from the implementation in our Lighthouse cities.

It is vital that we take a city-needs led approach to commissioning smart and digital technology. The Smart City marketplace suffers from 'solutionism' where pre-existing technological solutions are retrofitted to a city's needs. Sometimes this works out fine, but often it can result in a solution that doesn't quite fit the needs of that city, or a city investing in more than what it actually needs. To avoid this, we encourage city-needs led approach, or an outcome led approach, to commissioning smart infrastructure. Using design methodologies, cities should first identify their needs and outcomes and then express these to the marketplace who can then react and design/offer solutions specific to those needs.

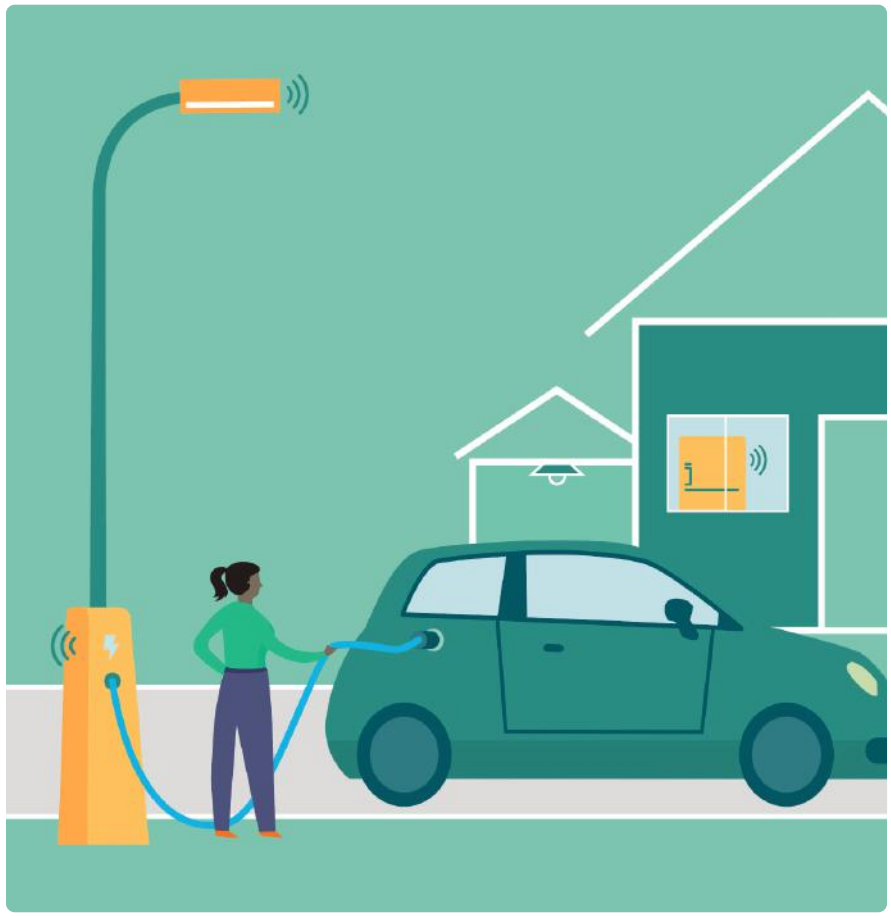
The value of public, private and academic partnerships. Through Sharing Cities, the value of partnerships has been proven beyond doubt. Where solutions have been designed that involve the demand side, supply side and academic experts from the beginning, we have seen the best results and the biggest commitment to sustaining the solution beyond the end of the grant funding. These partnerships force the demand side to consider how they express their demand to the marketplace. It forces suppliers to work out what is actually needed in their designs and what is superfluous. It introduces academic rigour from an early point and enables all parties to consider important issues such as monitoring and security issues from an early stage, issues that are often overlooked until procurement.

The value of city to city collaboration. Whilst all cities are unique, in many ways, cities have many things in common. Cities have limited experience and capacity in commissioning smart infrastructure services. By coming together cities can realise considerable value by comparing project approaches, sharing technical learning, developing joint commissioning tools and creating a common understanding of universal issues such as interoperability, standards, security etc. At a minimum we would encourage municipalities to engage with their neighbouring municipalities, but we would also encourage cities to engage with the networks that have grown in this area, the H2020 European City Network and a range of UK Smart Cities networks.

Citizen engagement can be your biggest ally or biggest barrier. Every city officer will tell you how important it is to engage with citizens and local communities. And yet time and again this does not happen early enough, and the methods used are often ineffective. We have known for a long time that when a municipality consults on a decision that has already been made then the citizens are not included on the journey, and this can store up problems for later down the line. We also know that when you try to rush through citizen engagement, it can have a detrimental effect on the procurement process by causing delays or opening it up to challenge. This is particularly relevant for smart technology. Smart infrastructure generates data about people's location and can sometimes be installed in a person's home. This has already caused public concerns and conspiracy theories in this area is rife. It is the duty of the city authority to engage with residents, involve them in the design of the service and address concerns about security and health head on.

Business models need innovation. We learnt a lot about business models and the difficulties in demonstrating value when dealing with innovation. It is hard to demonstrate a return on investment for a solution that is relatively new. The value in smart infrastructure is not 'traditional' – smart infrastructure generates some income, but it will also generate savings and have benefits that are social and environmental. Furthermore, the benefits for a city can often be cross-departmental (i.e. the public realm will pay for the infrastructure and the health department will get the savings). We have explored how we can better express value across social, environmental and economic factors, not just rely on a return on investment, but this needs further work and innovation. Investors are keen to invest but investable business models for smart infrastructure are still hard to come by.

The interplay between solutions can change the value proposition. We have tested the interplay between different types of solutions and the joint impact they can have on carbon reductions, service delivery and business models as part of the Sharing Cities district-based approach. Sometimes the business model for innovative technology fails to stack up on its own, but when 'bundled' with other technologies it can become more viable. For example, smart parking can be more cost efficient and effective when combined with smart lampposts.



4. Examples of smart street infrastructure from Sharing Cities

The roll-out of smart infrastructure can address many challenges, and these are likely to look different from city to city. Here we outline the main challenges and lessons learned from Sharing Cities.

Integrating disparate datasets and breaking down silos

From a technical point of view, the ambition should be identifying links between the different solutions (i.e. integration), moving away from separate 'silos' of data, considering not only the physical asset but also the services built by combining (currently) separate equipment and data. In addition, understanding the city context and the existing assets is of utmost importance. Careful consideration of the elements such as size, location, political and legal frameworks, climate, social and cultural behaviours will support the definition, selection and/or the solutions that best suit the city needs.

Integrating data into the Urban Sharing Platform

For Sharing Cities, the combination of the Urban Sharing Platform (USP) and the infrastructure measures such as Electric Vehicles (EVs), EV charging, parking bay management and smart lampposts creates a true smart city where data can be fused from different devices and sensors to provide new and valuable insights and actions for cities.

The following diagram illustrates the symbiotic relationship between the health of a city and how this is driven by improved utilisation of the data created by a city's smart infrastructure. By collecting and integrating the data from currently separate infrastructure or 'raw' data sources into an Urban Sharing Platform (USP is the Sharing Cities label for smart city or urban data platform) that data can be stored, integrated and analysed to create new smart data and in turn new insights which inform city managers and provide improved services to citizens.

Smart Cities can benefit from this platform by integrating data from different city IoT domains, such as traffic, air quality, public lighting, buildings' energy, and parking, among others. This is in order to analyse and extract city context knowledge, leading to improved city services, optimized processes or resource savings, benefiting the lives of those who visit, work or live in the urban space.

LISBON

In Lisbon, the Urban Sharing Platform used in Lisbon was developed by Altice Labs. It is a called a Digital Services Enabler Platform (DSEP), a multitenant data management and analytics platform equipped with a set of tools for collecting, storing, enriching, researching, processing and visualiszing heterogeneous data, enhancing the creation of value for different sectors of the economy.

Acronyms:

DSM: Digital Social Market; SEPS: Sustainable Energy Planning System; SEMS: Sustainable Energy Management System

Besides visualization over a city management dashboard where graphics and indicators are represented to give an overview of the city status to the city managers, services aslike the DSM (Digital Social Market) and SEPS (Sustainable Energy Planning System), both developed in the context of Sharing Cities, are very good examples of third party services which may consume data from the platform and shape it targeting different types of users; DSM is a gaming application offered to schools to promote environmental awareness and SEPS is a planning tool which will to help city managers to better use the city energy resources and predict how the energy solar panel infrastructure will grow.

The platform has been collecting information from the following data sources:

Provider	Data Source	Area	Description
EDP	Schools	Energy	Public Schoos Energy Consumption
	Zones (PTs)	Energy	Zones/Neighbourhood Energy Consumption
	Ongrid	Energy	Pubic Lighting Energy Consumption
	CPEs	Energy	Pubic Building Energy Consumption
	Private Buildings	Energy	Private Building Energy Consumption
	SEMS	Energy	Detailed City Hall Energy Consumption
CML	Waste Containers	Waste	Waste Container Volumes
EMEL	Gira Stations	Mobility	Cycling Stations
	Traffic Closures	Mobility	Traffic Closures
	Traffic Waze Jams	Mobility	Traffic Waze James
	Parking Zones	Mobility	Public Parking Sites
	Parking Lots	Mobility	Public Parking Lots
	Cycling	Mobility	Cycling Data
CEIIA	EV Charging Stations	Mobility	EV Charging Stations
	EV Vehicles	Mobility	EV Vehicles Consumption

We used the opportunity to implement pilot projects in Sharing Cities to explore the complex relationship between car sharing models, charging infrastructure, and parking availability, with the expectations from users.

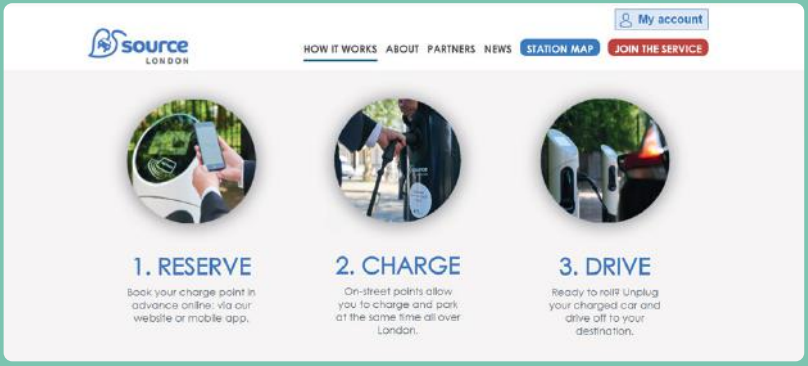
MILAN

In Milan, the Urban Sharing Platform (USP) was used to integrate data across all forms of mobility offered in the city to inform city decision makers. This helps improve the management of the city's mobility solutions in several ways. It helps manage the city's Mobility Islands – transport hubs situated across many parts of the city that provide multiple transport nodes including electric vehicles (and charging) and e-bikes to help make traveling more convenient and accessible to citizens. It also helps in testing e-logistic solutions, as the data platform is integrated with other mobility modes including e-bikes and e-vans.

The USP was also used in another way to help with city planning and management, specifically with e-bike schemes run by different operators across the city. In 2019, in collaboration with another European project, SynchroniCity, a dashboard was developed based on docked bike-sharing data collected through Sharing Cities and integrating dockless bike-sharing data collected through the SynchroniCity project. The USP provides mobility planning tools: Data indicating pick-up and release points for bikes across these schemes were collected and ingested to inform the city where the most frequent trips were taken, helping to improve the city's understanding of citizens' travel patterns.

LONDON

In Greenwich, electrifying car sharing has facilitated exposure to electric vehicles for users and has demonstrated how the 'back-to-base' model can utilise dedicated infrastructure. Emerging from this pilot was the support for a model which would move away from dedicated charging infrastructure for cars as battery sizes increase and charging becomes faster. In addition, the symbiotic integration between Electric Vehicle Charging Points and e-cars, we have exploited an innovative integration with smart lampposts. In Lisbon, the management platform integrates EV sharing, EV charging, e-logistic and smart parking sensors data, providing an integrated mobility vision for the city.



Data informing policy

Managing data, digitalisation and the integration of technology is increasingly important in urban design and planning disciplines. They can help us live better and more sustainably, from real-time monitoring of traffic & transport to enable immediate actions, to historic trend analysis and future forecasting to support policy and planning decisions. This includes data from various sensors, Wi-Fi networks, mobile networks and 5G, cameras, credit cards, crowdsourced data, data from apps and social media posts. This data provides us with rich information on a range of things including:

- Understanding our populations.
- The performance of hyperlocal assets.
- Community engagement.
- Placemaking.
- Intelligent prevention.
- Proactive wayfinding.
- Resilience.

When this data comes together in one place, for example in a data platform, it can become a powerful tool for city planners. It can be used to improve services for citizens, for example better transport systems, and can be used to remotely manage assets such as lampposts or parks. It can help to improve delivery of large contracts by driving efficiency and improving monitoring. And it can be used to respond to a specific need such as flooding, congestion, terrorism or, recently, the COVID-19 pandemic.

Data used on its own can, however, be misinterpreted, or mask issues that are not revealed through the data. Big commercial data sets alone will also not necessarily provide information to help guide a future pathway. This will require coordinated thinking by community and business stakeholders, planning, transport and urban design professionals. There are big challenges around collating and storing data for the public sector. This includes concerns of privacy and trust – who owns data and how it is used. The Sharing Cities programme worked with its cities and professional organisations to consider how to engage the public in local decision-making about data collection.

In the future, this information will increasingly fuel a city's 'digital twin'. This is a digital replica of a city, or at least part of a city, that can be used to run scenarios and test solutions before they are deployed in a real-world setting.

Data insights – examples

Here we have a few examples of how data insights from smart street infrastructure have been harnessed by the Greater London Authority (GLA) to address challenges and inform activities in London.

Electrical Vehicle (EV) chargers

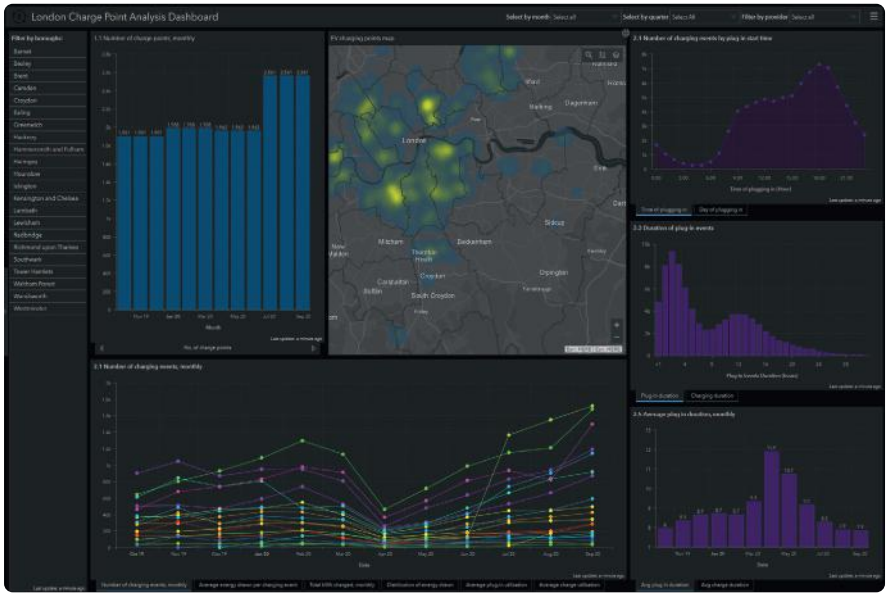
Information about the location and usage of London's network of electric vehicle charging points is held by a wide range of organisations. As work gathers pace to deliver new installations, it was important to learn from the existing charging points.

Through a core group of partners including GLA, London Councils, London Office of Technology & Innovation (LOTI) and TfL, we have been developing a single, open source database of charging points with key facts about them and a supporting tool to analyse usage patterns. We have developed automated processes to access data from the operators where it is available by API and encouraged others to share data in a more standardised way.

Overall trends in length of charging time versus connection time, time of day and location have been identified. This data forms a key input into understanding where to place future installations and also where to promote current spare capacity.

E-bikes

The Royal Borough of Greenwich wanted to better understand the potential of electric bikes in encouraging a shift away from driving in the Borough. A fleet of e-bikes was made available for residents to 'try out' for a one-month period, before making the investment to purchase one.



Electric Vehicle (EV) Data Dashboard

Traditional surveys and manual diaries only provide a snapshot of how the bikes are used and so the bikes were fitted with GPS tracking. The challenge was to distil the large volume of readings down to overall patterns and to share information with officers whilst maintaining confidentiality of the participants.

The raw location points for each of the 40 bikes was accessed several times per minute and stored securely. This was then summarised for each bike and each loan period, and also aggregated into individual 'journeys'. This aggregated information was then shared securely with transport officers.

Clear trends emerged with some users making lots of short journeys across the day and others just making one long return journey. Some users started off by using the bikes very regularly, whereas others started slowly but use increased across the month. We were also able to cross check with weather, the use of formal cycle routes and how hilly the terrain was.

Alan Turing Institute and sensor data for Busyness Project/Project Odysseus

The GLA needed to develop new 'rapid indicators' to understand how changes in national policy and restrictions during the COVID-19 pandemic affected the 600 High Streets across London. Information was needed to inform short-term measures and also to help design longer term adaptations.

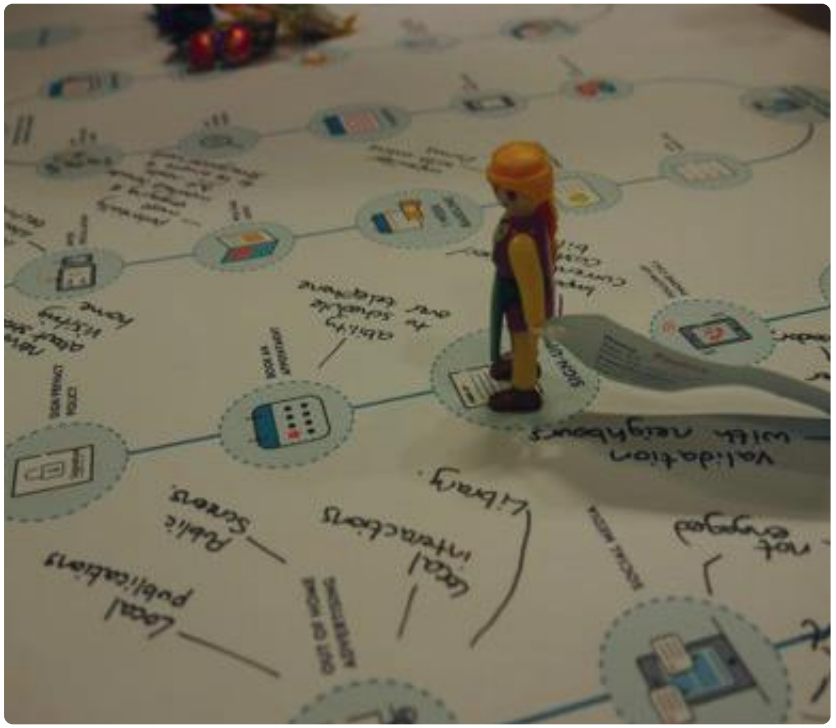
In addition to purchasing anonymised and aggregated commercial data for footfall and spend from O_2 and Mastercard, we worked with the Alan Turing Institute on estimating levels of social distancing from CCTV feeds (anonymised) and also pattern detection to flag changes from normal flows across the day.

The information is being used to support local schemes (for instance, pavement extensions and evening road closures) as well as to inform the work of the COVID-19 Recovery Board.

Busyness Project – Camera counts by road users

Engaging the local community

For Sharing Cities, including the local community and stakeholders in decisions on the design and implementation processes was highly important to our success. By doing so, we were better able to understand the local context and therefore consider in advance the specific areas and issues which the solutions were to address. Ultimately, this was to deliver better outcomes focused on the citizens' real needs, which led to these measures becoming frequently used by the local community.



LONDON / Selecting the location of EV charging smart lampposts in the Royal Borough of Greenwich

Smart lamppost electric charging is an exciting emerging business model for electric vehicle charging points (EVCP). The infrastructure is more discreet and flexible than other forms of charging points, meaning that it can be installed more widely across residential streets which often have narrow footways, or are part of conservation areas. In addition, it represents an opportunity to retain more control over EVCP infrastructure and to explore potential new revenue streams.

The borough provided a website where citizens could indicate where they wanted a charging point on a map and stated their reasons. This allowed the borough to identify areas where charging infrastructure was most needed. Furthermore, the data for EVCP locations is shared with the London Data Store so a city-wide map of EV charging locations can be provided to the public.

The EVCP usage data has also been integrated into a dashboard that can be used to analyse trends and support future policy decisions (see data insights example, above). Community engagement around this demonstrated high demand for the infrastructure amongst residents and indicated lack of charging facilities (many London residents do not have off-street parking) is holding back EV ownership in London. The charging points are currently being managed through a two-year concessionary contract where the operator (Siemens) collects revenues and is responsible for maintenance, and the borough receives 5% of revenues.

Balancing financial challenges against broader societal benefits

There is often a lack of understanding related to financing and investing in innovation in general, which is often linked to the high investment costs. This problem arises because many procurement decisions are primarily price driven, discounting other factors that could be of more importance. While sometimes solutions may be costly, it is necessary to understand the indirect non-fiscal benefits in social and environmental terms. These often do in fact translate into significant cost reductions, resulting from increases in the infrastructure efficiency or from the improvement in the services provided, over a longer term outlook.

Example: In designing and rolling out Sharing Cities' smart city solutions in an integrated fashion, we have succeeded in actually delivering substantially more benefits to our demonstrator districts in our Lighthouse cities than originally planned.

This has resulted in exceeding our Programme's targets to reduce carbon emissions and increase energy savings across many areas, including e-mobility, energy retrofits, and more.

One area where this is very apparent are our Smart Parking sensors, for which we ended up implementing more sensors than originally planned to cover different needs raised by users, as a result of our user-centric design process. The services provided across our 3 lighthouse cities, London, Lisbon, and Milan, expanded to include control of parking spaces for disabled drivers, loading bays, local public transport, and was also used to identify illegal parking and facilitating bus access for disabled people, and integration with charging stations.

Another area is Lisbon's e-bike sharing scheme, which has become a great success in having changed the entire city's mobility patterns. From having little to no cycling infrastructure and little public support in 2015 to date, the scheme has been scaled from the original planned pilot – with 30 e-bikes and 2 docking stations – to a city-wide scheme with almost 200 docking stations and 4,000 bikes over the next few years. The COVID-19 pandemic is accelerating this process, with the municipality understanding that investing in solutions that provide citizens with a safe and environmentally-friendly way of traveling across the city was a matter of top priority.

At the core of this process to realise value is data

In fact, while data is often still perceived as a static resource, its dynamic potential can bring many opportunities when done properly. Of course, this is not as simple as just providing access to data; cities must take a thoughtful approach to make sure that solutions provide the best-quality data possible intended for their need. By effectively harnessing data in this way, cities can make real progress and impactful change.

Considering a proper data management system and the right data collection mechanisms helps understanding patterns, attitudes, perceptions and satisfaction within the scope of implemented solutions. The ownership of data and its responsible and ethical use is also an important issue when multiple stakeholders are involved. For this reason, it is also important to create and sign data sharing contracts if private operators are involved.

Example: When it comes to e-bike sharing schemes, the redistribution management and the recharging of batteries are important hurdles that if not considered properly can reduce the profitability of the scheme, representing up to 30% of the total operational scheme costs.

Both docked or dock-less models always result in an unbalanced demand and, to ensure and maximize usage, the operator has to relocate bikes to areas of high demand. In this context, data is crucial to understand usage patterns and traffic flows, not only in terms of demand, but also in terms of the redistribution capacity of the system, and to ensure the scheme's profitability.

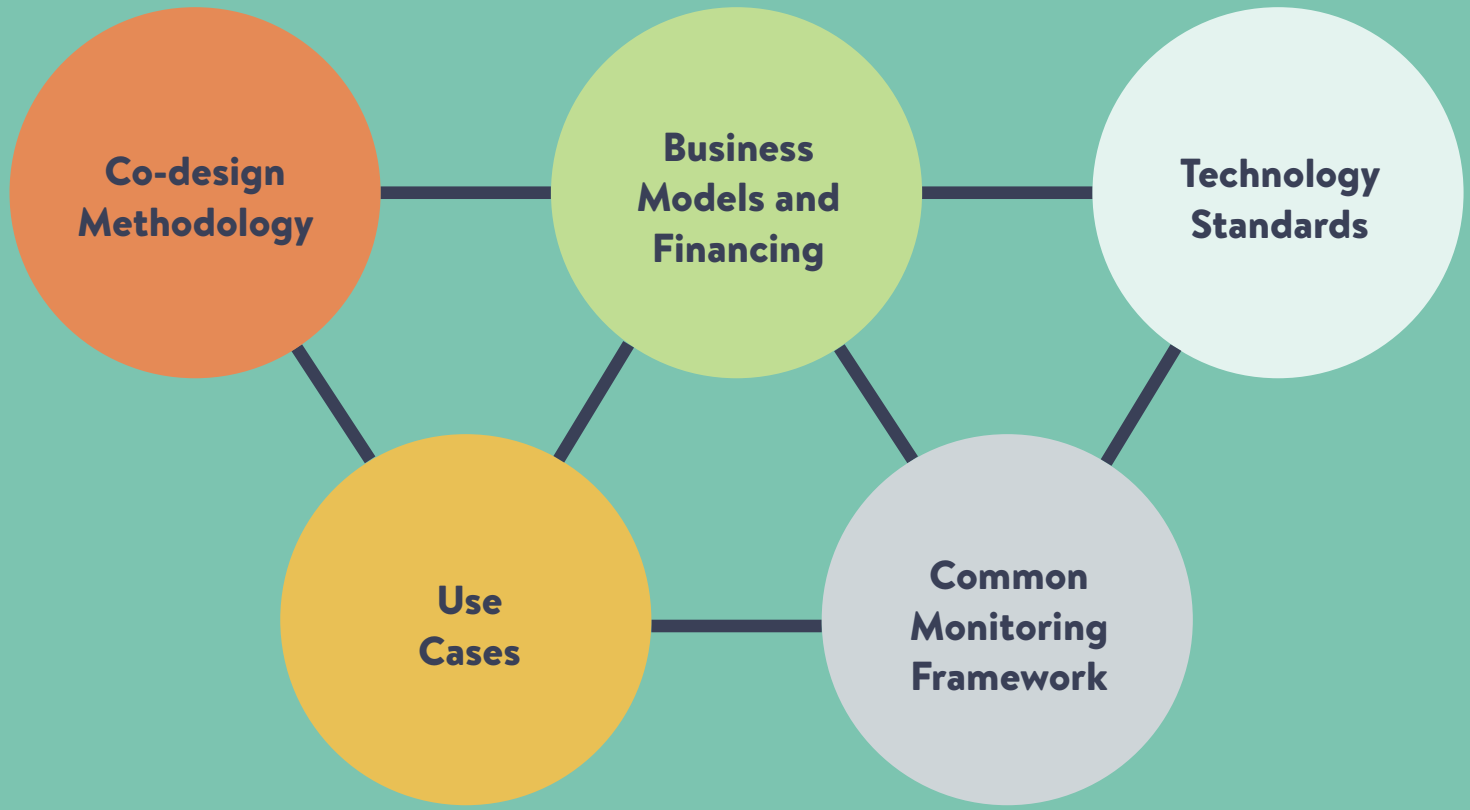
By integrating the bike usage data into a shared data platform and analysing usage patterns, it is possible to model the impact of incentives on future demand.

Lisbon developed a user-based bike reallocation system based on monetary rewards to improve the level of service concerning availability of bikes, trying also to decrease operational costs. In this model, the operator created a real-time incentive-based system that generates offers for users to move bikes from overcrowded docking stations or regions, to meet the expected demand of other locations.

5. Rolling out smart street infrastructure: A toolkit for implementation

Tools & resources

Sharing Cities developed a variety of tools, resources and information over the course of our 5-year programme, which might be useful for cities going through the process of deploying smart street infrastructure:



Co-design methodology – impact mapping

Before starting service design or planning, it is helpful to first define the deployments' goals with the key stakeholders involved in deployment. One useful tool to help kick-start this process is impact mapping. This is a collaborative process that brings together assessors, developers, project staff, stakeholders and end users. You can also produce logic models to reflect different stakeholders' views and the likely impacts of a project. You can create these for the whole project, or just individual parts with specific aims and targets. Sharing Cities partner Future Cities Catapult developed an Impact Mapping tool, which is summarised here.

You should start impact mapping before a project is launched if possible. However, it can be useful at any stage in the project lifecycle (before, during or after rollout):

1. Rationale

- **Issue and context** – what activity is being proposed? What is the frequency? What city needs does the smart street infrastructure deployment address?
- **Aims** – what are your ultimate quantifiable objectives? What barriers is the activity meant to address?
- **Why it should exist** – what are the key reasons for this technology to be deployed or continue to operate?

2. Inputs

- **Activities** – what is going to take place and how will it happen? Why are those activities key to the scheme?
- **Timeframe** – what are the timeframes for short, medium, and long-term outcomes?
- **Who are the stakeholders** – who will be carrying out the key activities?
- **Resources** – what physical, financial, intellectual and human resources are needed?

3. Outputs

- **Beneficiaries/users** – who will be impacted by the smart street infrastructure deployment?
- **Product/services** – what are the key products made or services offered?

4. Outcomes

- **What are the expected outcomes** in terms of economic, social and environmental factors, in the short, medium and longer term?
- **Short term** – what immediate outcomes or benefits are there?
- **Medium term** – what outcomes will take a few months to realise and measure?
- **Long term** – what impacts will either be measured over years, or are harder to measure in the shorter term? These will be linked to metrics that measure the shorter-term outcomes.

The logic model template encourages project leaders to think about how the deployment addresses a city problem, citizen need or gap in the market. How does this rationale link to economic, social and environmental outcomes? These can be divided into immediate, medium and long-term outcomes.

Logic Model Tool

1. RATIONALE

Issues & Context

Aims

Why it should exist

2. INPUTS

Activities

Stakeholders (The people/organisations who will be working to make the DSM a reality)

Resources (Physical, financial, intellectual and human)

3. OUTPUTS

Beneficiaries / Users

Output products / services

4. OUTCOMES (ECONOMIC, SOCIAL AND ENVIRONMENTAL)

Short term

Immediate

Medium term

Long term

As the project continues it's vital to stay in touch with key stakeholders to maintain their support for the scheme. Potential stakeholders may include:

Within local government

- Transport department.
- Planning or land use management.
- Environment department.
- Community engagement and Communications teams.
- Smart City lead.
- Chief Technology Officer.
- Policy advisers.
- Politicians.

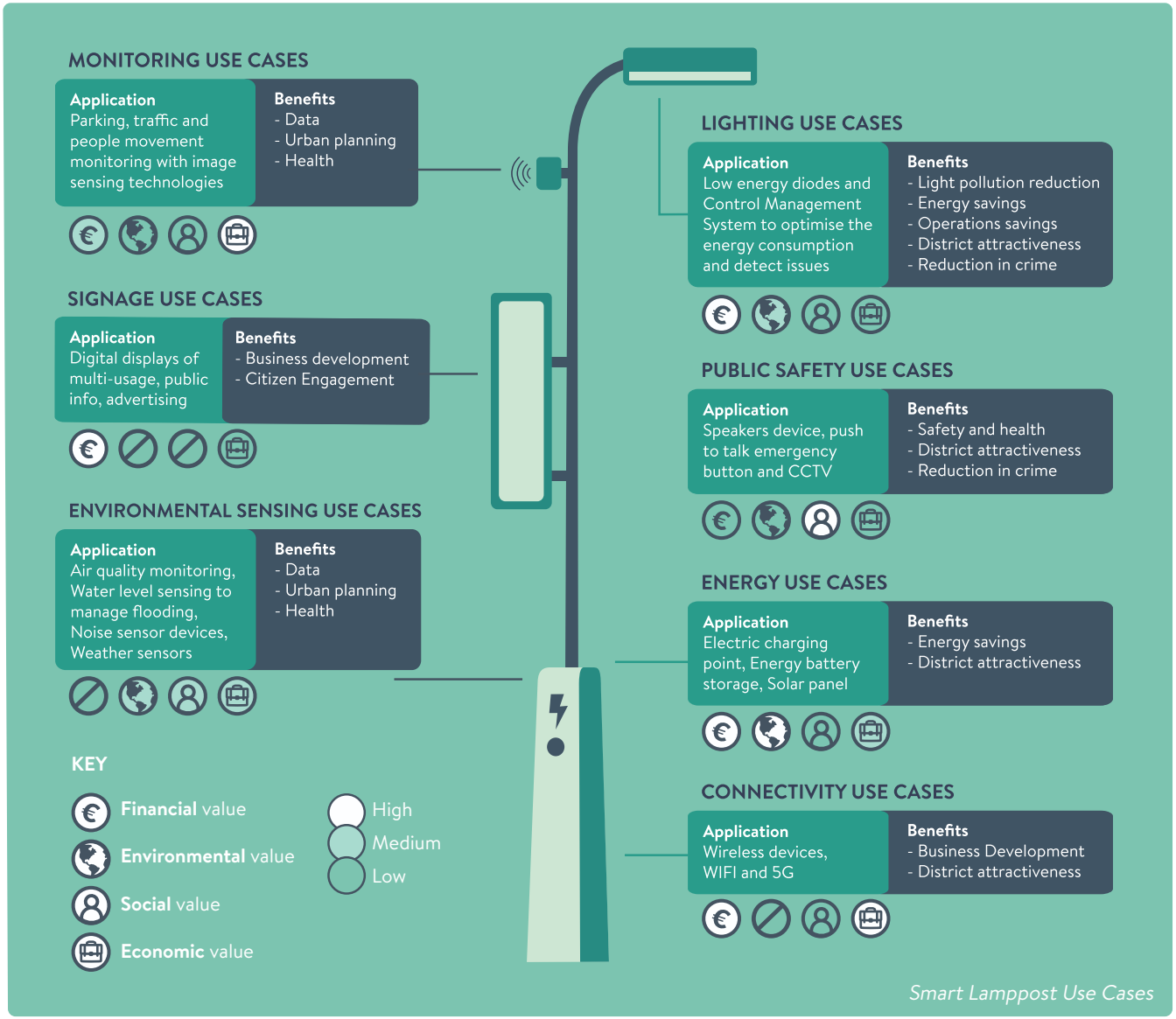
Others

- Local community representatives.
- Local business owners.
- Funders/financiers/sponsors.
- Service operations and maintenance providers.

Use cases – methodology and examples

To effectively plan for a smart infrastructure deployment, you must understand how it will be used. A use case is a specific situation in which a product or service could potentially be used. In this section, smart lampposts are used as an example to illustrate and describe how these tools and resources can be applied in smart street infrastructure deployments more widely. If you would like further information about smart lampposts, have a look at our booklet on smart lampposts.

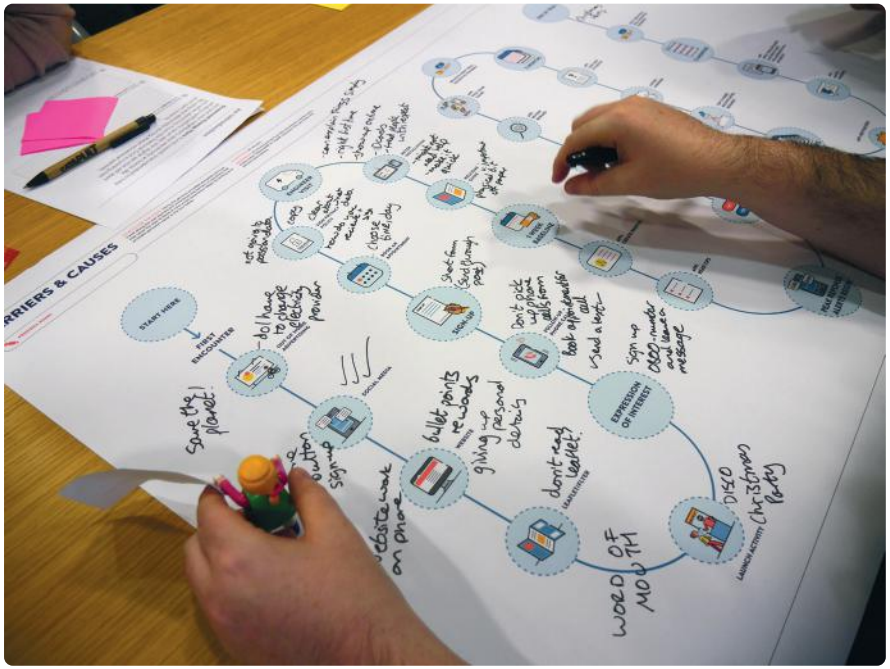
For example, a smart lamppost has many use cases including LED, 5G, air quality and noise monitors. Through Sharing Cities we identified and developed many of these use cases. The diagram outlines different use case areas for sensors on smart lampposts and you can see a full list in *Appendix*.



Smart Lamppost Use Cases

Different types of smart street infrastructure will likely include a wide demographic. There's also an ecosystem of actors, or stakeholders, that will be involved in making the deployment run effectively. This includes maintenance staff, commercial partners and data providers.

Developing a set of use cases can help you identify different user types and their reasons for engaging with the technology. This will enable you to design a service that considers all the necessary functions and technical specifications to fulfil user needs. To help you with this activity, Sharing Cities has developed use case templates, examples and a description on the methodology.



Use case methodology

One important consideration is related to the integration of the different IoT solutions. Identifying links between the different solutions is usually a challenge, commonly resulting in overlaps that are not sufficiently exploited, or even in a duplication of effort and costs. One of the most common mistakes is to evaluate the different technologies available as a way of responding to a specific need. In fact, outcomes may be much more positive if you consider the opposite way of thinking – placing needs at the core of this assessment and, exploring the best way to address these needs and ensure efficient implementation, regardless the nature or number of the solutions to be considered.

In Sharing Cities, we followed a 'Use Case' based approach for this purpose. This is a frequently used method in IT design, usually aimed at defining how a system is supposed to be used, ensuring an articulation of its different functions (or needs). In practice, this is the primary method by which the needs, goals and vision are elucidated and captured, in the form of an engagement mechanism. For this reason, while creating 'Use Cases' a direct dialogue with the end user is often required, to determine and ensure capturing the specific needs to be addressed.

This analogy between an IT system and the technological (IoT) solutions proved to be useful during the programme, allowing the exploration of existing interdependencies between the different needs and/or problems intended to be solved.

Project partners followed an iterative approach and shared method to develop use cases:

1. Initially, project partners responsible for delivering the products and assets drafted Engineering Use Cases. This represented the identification of the specific technical issues that we wanted to resolve containing (when applicable) the details of the basic functions required from the equipment, products, data, interfaces and communications.
2. Based on the Use Cases drafts, our project partners leading on community engagement focused on providing details on how the infrastructure and data was intended to be utilised by citizens. This way the Use Case descriptions were augmented with richer detail about the local community context and benefits.
3. Based on the interaction with citizens and stakeholders, we looked at proposing additional Use Cases which in turn had to be validated by project partners delivering the products.
4. With the Use Cases description validated, the resulting Smart Use Cases were then utilised to derive system requirements and in turn the design process.
5. Finally, responsibilities were assigned to project partners aiming at the actual implementation of the solutions addressing the requirements defined and agreed within the scope of the Use Case.

Here is a completed example of a use case on smart lampposts from the Sharing Cities Programme

UC 3.4.2	**Additional energy savings / optimisation**
Description (narrative)	As a city manager I wish to increase the level of energy savings beyond just LED lamp replacement – by trimming and dimming the lights to suit environmental and other circumstances
Functions	Sunset/sunrise times are incorporated in the system Ambient light conditions are monitored Footfall and traffic volumes may be monitored to reduce light when volumes are low Political / societal opinion and feedback is captured and built into lighting controls Reporting on a regular basis for issues, and for energy consumption (over/below norms) to ensure value is maximised and balanced against other factors.
Pre-condition	
User insight/ need the use case responds to	Assuming citizen user is referred to here, there is little articulated need specific to this use case. Indeed it is the counter issue (i.e. insufficient light) that is the resulting down-side risk that would engage the user.
Actors involved (stakeholders)	City Council; Transport Authority; DSO; User (Acceptance); Businesses; Energy Agencies; Meteorological agencies (advanced warning); Data Consumers
Incentive for citizen	Limited. Savings generated are unlikely to be visible in e.g. council taxes.

UC 3.4.2	Additional energy savings / optimisation
Description (narrative)	City council environment/energy officers wish to make energy cost savings (and to an extent GHG reductions) through optimising streetlight intensity levels depending on local weather patterns and other factors (passage of people and cars) through smart street light controlling, whilst still providing appropriately attractive and safe environment for society.
Functions	The streetlights are installed with LED luminaires and a CMS (control) system that has the capability to dim individual lamps (or groups) based on optimising ambient light conditions with required set lighting levels, adjusted to cater for low footfall or low traffic flows (e.g. night time). This results in additional savings over and above just upgrade to LED. Assumption is LED is in place, however further additional benefits are available through: • Dimming dependent on traffic flow – area specific • Trimming due to ambient/environmental light levels (e.g. temporary rain/storm) • Dimming through high local (e.g. retail) lighting levels • Excluded as these are not savings; they're additional energy use • Trimming through safety and public movement

For more examples and templates, please contact Sharing Cities by emailing: **pmo@sharingcities.eu** or tweet **@CitiesSharing**.

UC 3.4.2	Additional energy savings / optimisation
Pre-condition	
Policy	Policy focus on energy savings, and preferably support for smart lighting
Legal & Regulation	No specific issues envisaged for this use case
People	No significant input required. Support for (lamp) outage reporting a benefit (not for energy, more for safety)
Operational	Clarity of role of city and / or service provider; and agreed collaboration
Process	Existing operational SOPs are in place as a basis to work from
Data	Energy consumption data are preferably lamp levels (if not then in small clusters). Weather (light levels) data, preferably thru local ambient light sensing.
Technology	• CMS system in place • Grouped controllers • Sensors for ambient lighting levels (at beyond individual lamp level) • Movement tracking (e.g. cars; people)
Assets	Modern lighting poles; multi-bulb LED luminaires; CMS system; Sensors
Performance / Criticality	Low risk use case; deals with system optimisation

Business models and financing

A business model is a high-level strategy to determine commercial viability of rolling out a product.

The lighthouse cities' experiences highlight several key recommendations for developing a business model.

Build and maintain strong relationships with your stakeholders early on

Having close relationships with your stakeholders will make it easier to roll out the scheme. More importantly, **it is vital to establishing contracts and agreements around data sharing, asset/network performance and maintenance**. By getting stakeholders involved as soon as possible, you can make best use of their know-how.

Use questions for the most relevant aspects you want to address

Decision makers will want to know what options have been looked at before they make their decision. Posing questions can help you better understand the different existing options, and think critically about them. Lighthouse cities considered questions like:

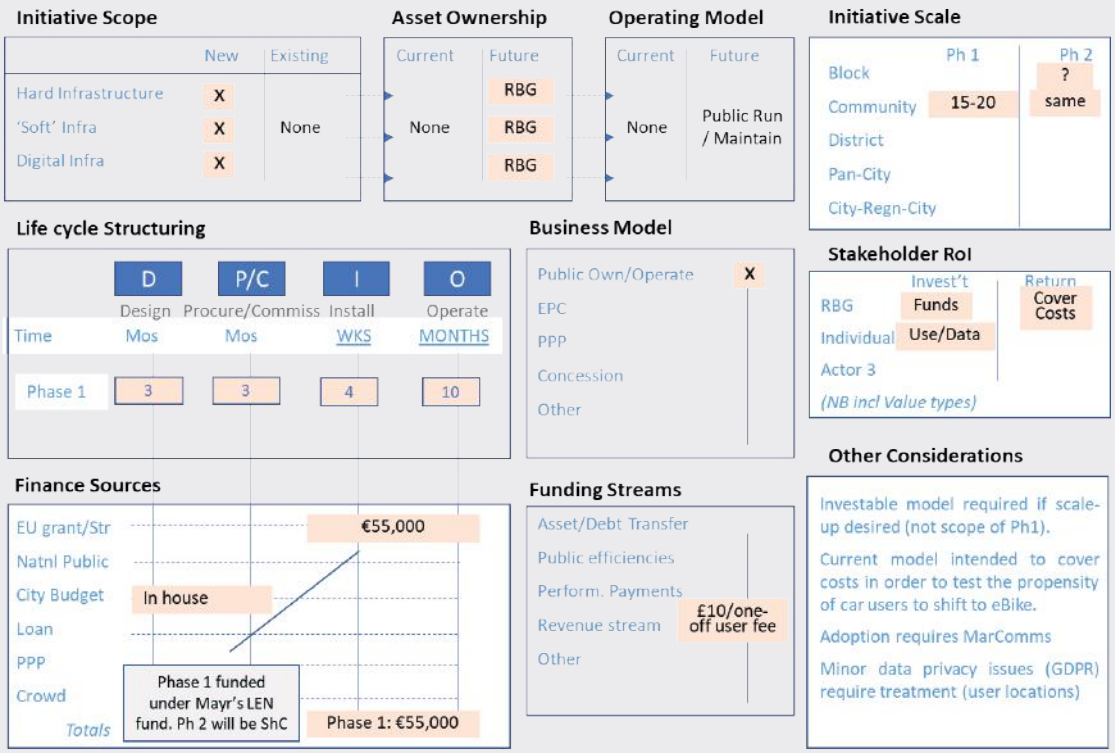
- What policy outcome is being addressed?
- What customer problem or challenge is being addressed?
- Who is the target customer?
- What value is being delivered?
- How to understand, access, engage, encourage participation, and keen customers?
- How to define and differentiate the proposition? (vital in today's world)

Use templates to capture and collect information from everyone involved

As well as engaging stakeholders, you must capture any lessons learned. Using templates can help you to collect a consistent and standardised set of data for different options, which is especially important for comparison and evaluation at a strategic level. Templates should be simple and should focus on the core factors of the business model. These include asset scope, scheme scale, ownership, contracting considerations, service/infrastructure operating model, finance, funding, ROI, business model preferences.

Sharing Cities has reviewed the business model and financing approaches taken by these projects as well as other lighthouse programmes. Business Model and Finance (BM&F) templates have been created to help outline the plans for each measure. See next page for an example from Greenwich, London.

To contact Sharing Cities, email: **pmo@sharingcities.eu** or tweet **@CitiesSharing** for blank templates or more information about this tool.



This captures key information around how the city aims to roll out the measure from a business model and financial perspective. It addresses:

- What will change between existing and planned measure implementation?
- What scope, ownership, operating model, scale is intended?
- How will the city go about design, procurement, rollout and operation and how much money (if known) does it plan to spend?
- What business model is (or options are) anticipated?
- Where the returns stream(s) will come from to pay back investments?
- The various stakeholder investments and returns (of all forms)
- Various other considerations that may or may not be relevant for the city/measure combination.

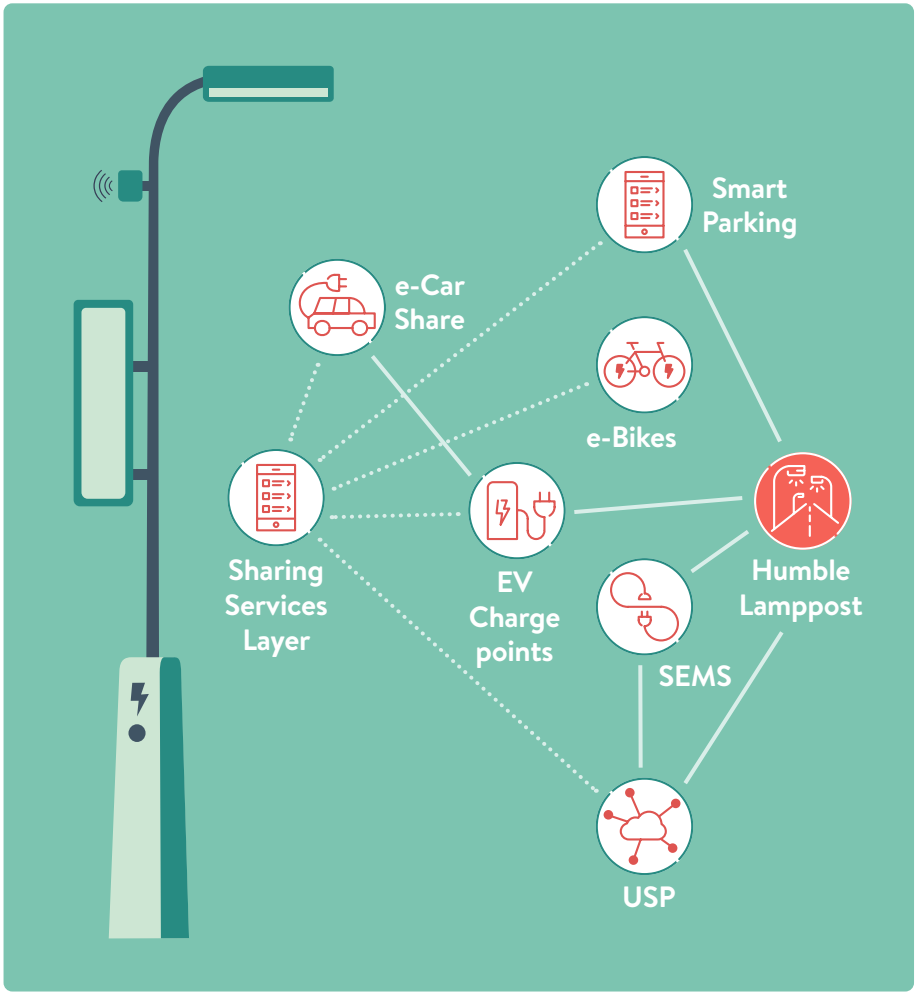
Bundling of smart solutions to support scale

In implementing one form of smart street infrastructure, cities may consider plans for associated smart services. The figure shows some of the other assets and services that cities may wish to align with smart lamppost implementation plans. Given the nature of these other services, this reinforces the need for cross-functional collaboration. It may also involve work to align business cases and consider joint business and financing models.

Collaboration to share experiences and learn, particularly given the relatively new nature of smart services, is clearly of value to explore. Collaboration between districts within a city, or amongst cities can lead to considerable additional financial and other benefits, through demand aggregation and economies of scale. This can also help de-risk or share risk between cities that test and prove different smart features.

Collaboration on design amongst cities (i.e. greater levels of commonality leading to standardisation) will lead to reduced costs; even with no joint procurement. Benefits will likely only accrue with joint procurement.

You can find out more about bundling and demand aggregation, described within the context of smart lampposts, in the Sharing Cities report on Deliverable 3.9, Smart Lamppost Component-Based Design.



Complementary services to the 'Humble Lamppost'/Smart Lamppost

Establishing a common monitoring framework

Adopting a common monitoring framework means you can compare metrics with other similar schemes globally, and easily identify where performance can be improved. CITYKeys is a performance monitoring framework funded by the EU's HORIZON 2020 programme. It has worked with cities to create and validate key performance indicators and data collection procedures. By so doing, CITYKeys has enabled common and transparent monitoring and easy comparison of smart solutions across European cities.

Find out more at: www.citykeys-project.eu/citykeys/project

Sharing Cities also developed a common monitoring framework to evaluate performance of its smart city measures. The methodology for identifying the measurable indicators included:

A common framework – The programme created a common monitoring and evaluation framework to define both the evaluation targets to address and evaluation methods to use. These included processes covering data collection, data standards, data quality, data stewardship and the definition of key evaluation indicators.

Local rollout – The overall evaluation framework is developed centrally. However, responsibility for putting the framework in place resides locally with relevant research and delivery partners in each city. This is because the successful implementation of complex data collection protocols depends on detailed local knowledge. This is only available among local partners. Moreover, local knowledge is critical for the design of proper control.

Target salience – Each measure entails a set of technical developments which will impact directly and indirectly on people, business and the public sector. It isn't possible to monitor and evaluate every possible technical and impact dimension. Rather, the choice was based on several considerations. These include the salience of each potential evaluation target in respect of its policy and market significance; its practical contribution to scaling and replication, and the practical opportunities to collect relevant high-quality monitoring data.

Control of covariance – Each measure was introduced into a complex environment in which many different factors stood to influence a particular outcome or evaluation target. It is vital that the monitoring and evaluation activities collect enough data on these covariates to enable proper statistical control for their effect. Ensure that enough time is allowed for data to be collected both before and after measures are launched.

Common core of evaluation targets – A key part of the common evaluation framework is to develop a common core of evaluation targets and associated KPIs. In addition, data and measurement processes must be put in place consistently across all three cities. This common core has provided a base for Sharing Cities to aggregate experience and learning across the participating cities and more widely. This common core has been selectively augmented by further evaluation targets that are specific to the city and/or measure.

Dynamic impacts – In developing evaluation targets, we realise the measures put in place by Sharing Cities will have a range of impacts on different stakeholders. These impacts may change over time as stakeholders learn and adapt their behaviour and the measures themselves evolve. Our experience suggests that it is useful to structure consideration of these impacts under five broad headings:

- Technical performance.
- Institutional and business consequences.
- Impacts on attitudes and behaviours.
- Wider systemic impacts including environmental, security, safety and sustainability.
- Economic and social implications including those affected by efficiency, equity and social inclusion.

More information about the Common Monitoring Framework developed by Sharing Cities can be found here.

To contact Sharing Cities, email: **pmo@sharingcities.eu** or tweet **@CitiesSharing** for more information about this tool.

Technology Standards

As discussed earlier in this Playbook, Interoperability between different systems is one of the challenges of rolling out smart street infrastructure. One of the ways to address this problem is through uptake of common technology standards by cities in the deployments of IoT.

Sharing Cities developed a listing of the 353 standards that relate to road lighting or street lighting which can be found on page 57 of Section 6.6, D3.9 Smart Lamppost Component-Based Design v01c.

More broadly beyond Sharing Cities, the global smart cities community is keenly aware of the challenge posed by interoperability limitations and cities are actively cooperating to address the root issue of incongruent technologies. The Open and Agile Smart Cities (OASC) network has published a listing of Minimal Interoperability Mechanisms (MIMs) as universal tools that anyone can use to be able to exchange and make use of information from systems, data, and services between cities and suppliers around the world. The MIMs have already been adopted and implemented across the cities of Antwerp (Belgium), Manchester (UK), Helsinki (Finland), Santander (Spain), Milan (Italy), Eindhoven (Netherlands), Carouge (Switzerland), Porto (Portugal), Seongnam (South Korea), and Bordeaux (France).[3]

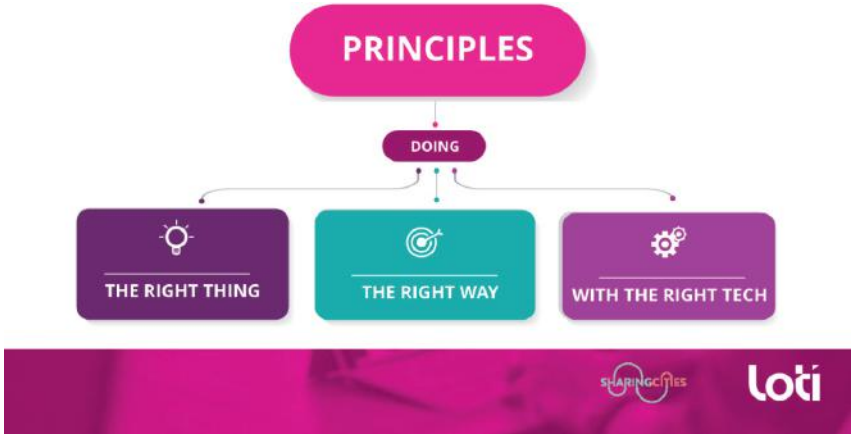
The next step of the OASC's approach is the SynchroniCity project, based on the simple question of the 'minimal common technical ground needed in a global market for IoT-enabled services for cities and communities'.[4] This will roll out a wave of new services based on the MIMs, with initially 49 market deployments to be implemented in 18 cities. For more information on the MIMs and the implementation in the SynchroniCity project visit synchronicity-iot.eu.

Applying a Smart approach to implementing the Internet of Things (IoT) in London

Sections 2 and 3 of this Playbook describe the challenges, importance and value of adopting a strategic approach to rolling out smart infrastructure across a city or local area. Section 4 details our learnings from the implementations, and the Sharing Cities experience more broadly. A strategic approach to the roll-out of smart street infrastructure and IoT not only covers technical and financial aspects but fundamentally underscores how a city views its priorities, collaboration opportunities and public narrative with its citizens.

The challenges are particularly pronounced in a city like London, where the federated nature of 33 administrative local authorities makes strategic ambitions difficult across the pan-London landscape. Drawing upon the lessons outlined in this playbook and combining elements in the London context, we applied these principles in a design sprint in March 2020 with the London Office for Technology and Innovation (LOTI) to develop solutions which address the challenges and opportunities presented by IoT. The IoT Framework developed as one solution – a model to establish a set of considerations for a common approach to IoT in London, with principles relevant to city officers beyond London.

Two other outputs emerged from the design sprint with LOTI, both at the prototype stage: (a) to create an information portal for local authority officers in London to foster a culture of shared learning around their IoT deployments and (b) to develop a 'plain language' narrative to engage with the general public and build trust. These outputs reinforce important elements from the Sharing Cities experience, on collaborating with your peers in city authorities and communicating with your citizen stakeholders. You can find out more details about the IoT design sprint and see new developments on LOTI's IoT webpage.



Appendix

A list of use case examples for sensors on smart lampposts.

PLACEMAKING

Internet access and networks – 5G, public Wi-Fi, LORA

LED lighting

Footfall counters in town centres to attract business

Dynamic street light controls (CMS) can be used for energy saving (trimming and dimming), cultural events and crowd management.

Monitor street infrastructure assets to reduce manual inspections and maintenance costs

Monitor roads, cycle routes, manholes and drain conditions to improve safety and reduce maintenance and insurance costs.

Monitor road temperature to provide a more effective gritting service in the winter

Monitor waiting times at key services (such as housing office, tips etc) to alert residents to busy times and reduce congestion

Tracking internet use of shoppers over Wi-Fi to support local retailers advertise intelligently

Monitor occupancy in homes and commercial buildings to inform managers and maximise usage

Monitor air quality and noise around construction sites

Monitoring water levels of rivers and sewers to provide early warnings of flooding

Monitor activity in fly tipping hot spots to record fly tippers in action or trigger alerts

Monitor noise pollution at noisy locations to ensure compliance

Monitoring of graffiti hotspots for faster response to unwanted activity

SUPPORT INDEPENDENCE

Location and habit tracking for older and vulnerable people and their carers, to support people to live independently

Monitor blood sugar (diabetes) for carers to support vulnerable residents live independently

Tracking health and social care assets across the boroughs

Monitoring of attendance to key appointments, early alert system to compliment community alarms

Health signposting depending on information entered into a health app

Smart network of early first responders (people qualified for heart attacks, CPR etc)

Smart suicide prevention at hotspots

Integrated defibrillator network on smart lampposts

INTELLIGENT SAFETY

Monitor safety alarms in homes to improve safety, reduce visits and notify of low batteries.

Spotting suspicious behaviour

Integrated CCTV networks

Acoustic sensors monitor crime/ASB and alerts authorities

Electronic ‘Concierge’ for Vulnerable Victims

Safety through unobtrusive interventions

Tracking of lone walkers

Digital Neighbourhood Watch

Witness and suspect identification through facial and audio recognition

Protect unaccompanied children at night

Increase safety around schools

Emergency lamppost alarms

Tracking of lone workers to improve safety

PROACTIVE TRANSPORT

Monitor traffic movement and volume to reduce congestion and improve air quality

Lamppost EV charging

Air quality monitoring to support traffic flow and health improvements

Wayfinding apps to help vulnerable people navigate the streets (ie. an app for blind people that uses lamppost location sensors).

Parking space and delivery bay monitoring to reduce congestion, improve air quality, alert enforcement officers

Geo-Fencing: Pedestrian monitoring for commercial gain/events

Locations sensors to support Connected Autonomous Vehicles

Community-driven route planning

Last mile logistics coordination and management to improve air quality and congestion

Number plate recognition (congestion charging, safety etc)

Tracking highways assets across the borough

Responsive/adaptive signing

HOUSING & DEVELOPMENT

Environment monitoring of housing assets to support proactive maintenance

Heating monitoring of social housing residents to support fuel poverty

Monitor fire doors in buildings

Bin usage monitoring of communal and street

Monitoring of leaks, temperature and pressure of water piping

Monitor overcrowding in social housing and HMOS

Monitoring of allotment use to ensure usage/increase availability and revenue

Moisture (and condensation) sensors in housing stock and potentially other sensitive buildings

Show development plans through VR

Accessible digital proposed development boards

Easy and accessible digital democratic decision making

BUILDING COMMUNITY

Space for social interaction and activity that connects place with digital

Archived libraries item tracking, removing need for manual cataloguing system

On street community information hub

Encourage visitors and residents to discover, engage and respect their local area

VR and gamification

Attract people to healthier locations

Encourage people to discover new places

UNDERSTANDING POPULATIONS

Data collection on citizens, demographics, location and journeys

Collects data on activity, environment and sentiment around London

'Urban sensing' – data collection on community moods/feeling

Find who is missing from the high street

Diagnosing solutions for traffic congestion

References

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2 https://www.london.gov.uk/sites/default/files/smarter_london_together_v1.66_-_published.pdf

3 https://oascities.org/international-coalition-of-cities-builds-global-interoperable-smart-cities-market/

4 https://synchronicity-iot.eu/tech/

Acknowledgements

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