A guide to SynchroniCity

A universal approach to developing, procuring and deploying IoT- and AI-enabled services.

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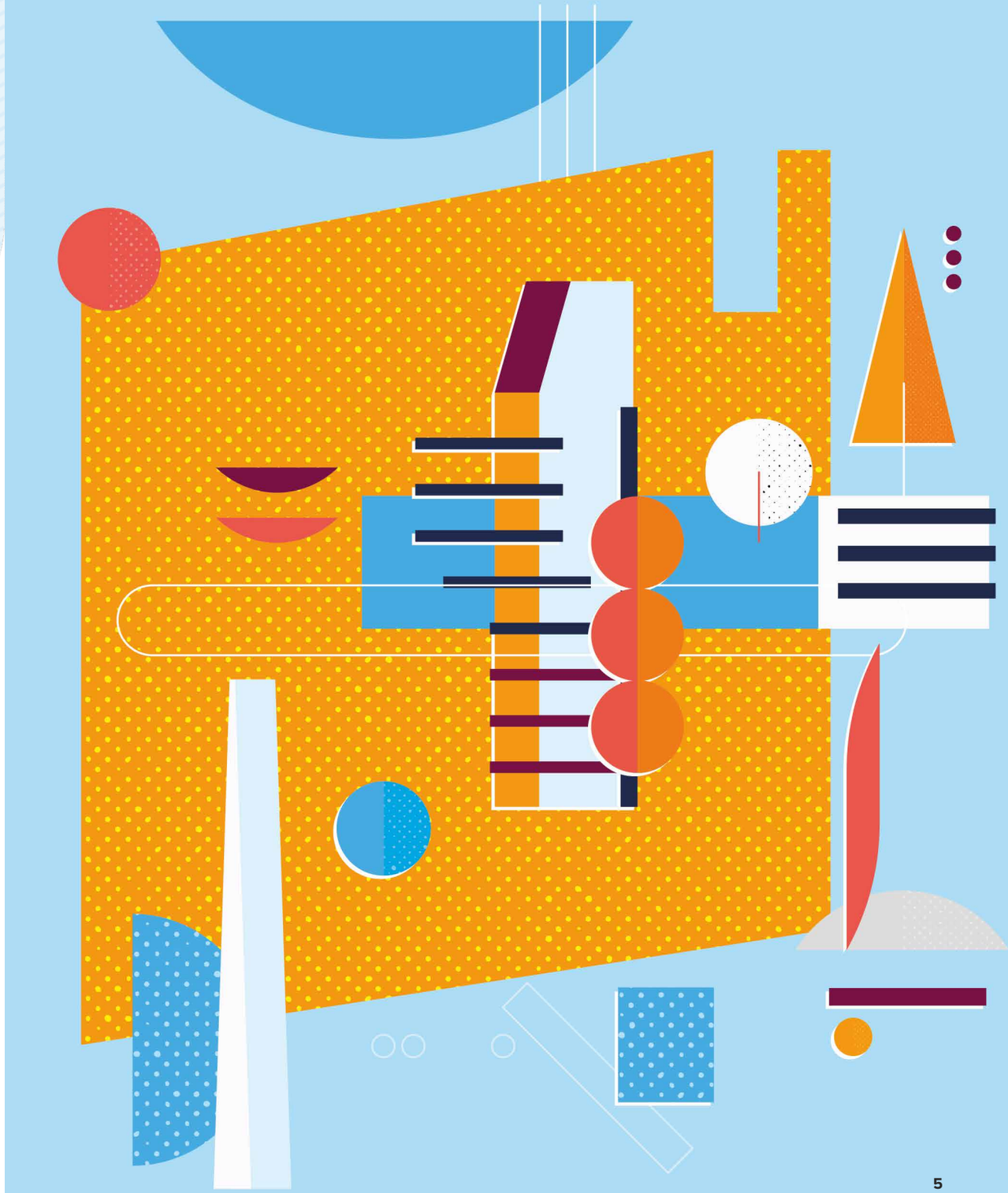
Switzerland

South Korea

“Encourage your Mayor and Minister to sign the ‘Join, Boost, Sustain’ declaration via LIVING-IN.EU. Co-create with fellow cities, communities, and citizens. Encourage use of the MIMs. Spread the OASC and SynchroniCity movement. You’ll have contributed to the birth of a new market, win-win for all.”

Olavi Luotonen, Programme Officer, EC, DG CONNECT



How to use this guide

This is an introduction to the SynchroniCity framework and a guide for implementation. We introduce you to the concept of 'minimal interoperability mechanisms' (**MIMs**), reflect on the SynchroniCity project that validated this concept, and provide guidance on how we can all take the SynchroniCity movement forward. Our ambition is to bring together national governments and policymakers, local authorities, and technology providers to work together in addressing our common challenges to achieve our common goals. To realise the SynchroniCity vision, we must all act; we all have a responsibility to ensure our cities and communities are the most sustainable, prosperous and inclusive they can be, so please use this guide to get started, and join an exciting and pioneering movement!

Quick start guide

For an overview of our shared journey.

► **Go to page 32**

For a closer look at the journey for local authorities.

► **Go to page 36**

For a closer look at the journey for technology providers.

► **Go to page 46**

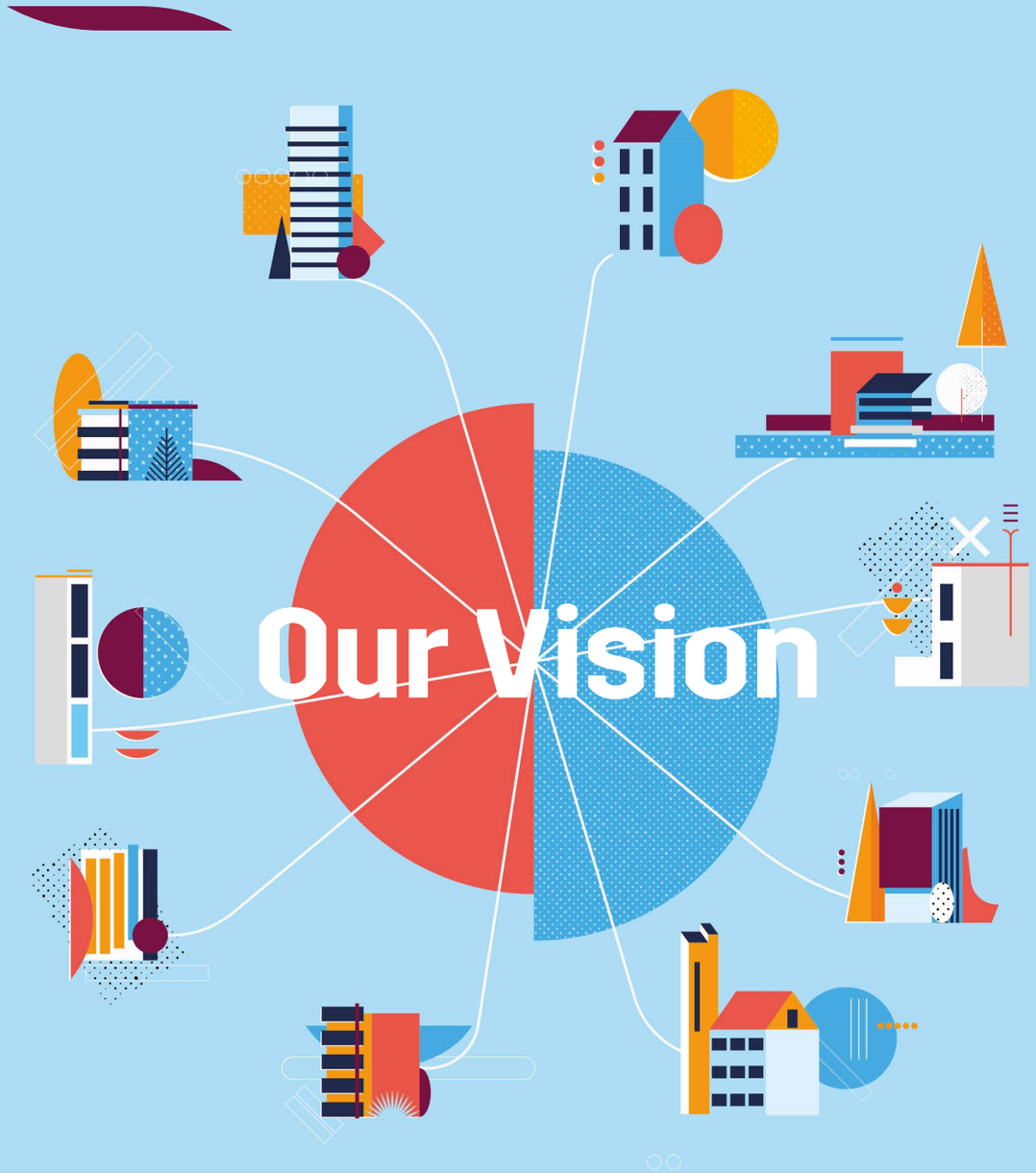
For a closer look at the journey for national and international regulators and policymakers.

► **Go to page 56**

Glossary and external resources

See the glossary on page 61 for help with keywords, these will be highlighted in bold throughout the guide. For more detailed information, we have linked some resources on page 62, which we will point out when useful along the way.

Glossary **Resources**



We are surrounded by visions of new technologies that promise to radically improve our lives – 3D-printed buildings, Artificial Intelligence (**AI**) companions for vulnerable citizens, and flying taxis to reduce congestion on our roads.

Flying taxis are unlikely to be available anytime soon but technologies like the Internet of Things (**IoT**) and AI-enabled services, can offer us real, tangible benefits now in understanding and responding to the needs of our cities and communities.

Using sensors to capture vast amounts of real-time data from their environment, IoT can give us a far more accurate and holistic understanding of how a place works. This also allows us to make more informed predictions and decisions when planning for 'place'. All of this leads to more efficient, effective and affordable products and services for citizens.

Technology companies are rapidly capitalising on these opportunities with highly desirable products and services that put the user first. However, we are yet to experience the same level of innovation in our public services – often stuck with outdated communication methods, inefficient and siloed delivery, and inadequate feedback systems.

The impact of this is significant: consumers who can afford to, turn to the private sector to meet their basic needs and wants, whilst those who can't afford to are left with poor quality, unaffordable and outdated services. This exacerbates the social and economic divides that our public services are designed to reduce. All the while, large technology companies are using the huge amounts of data gathered from their growing user-base to create more innovative products and services and gain greater dominance over the digital market.

It is hardly surprising that local authorities are struggling to navigate this digital market and innovate, let alone transform their service delivery. Constrained by budgets, inflexible procurement models, and changing political agendas, they are also expected to deliver innovative services within siloed, bureaucratic and risk-averse environments. They have an almost impossible task on their hands. These rigid and closed systems mean that efforts to enhance technical capabilities are deprioritised, young innovations are rejected based on a lack of evidence, and any data that is gathered is not always integrated or shared.

For local authorities that are fortunate enough to work within an open innovation culture and with sufficient funding, the market conditions simply don't exist for them to easily procure, deploy and scale effective digital solutions. Unable to 'shop around' for the best services to meet their strategic

- objectives, when a large technology company offers an end-to-end solution that promises to meet all of their needs, it can feel like the only viable option. But this inevitably leads to vendor lock-in, and local authorities soon find themselves restricted to one company's IT system, protocols and products for many years. This also forms a significant barrier to entry for smaller technology providers, who are locked-out of these opportunities.

Additional barriers also exist for small technology providers trying to engage in this market. If a local authority has a specific technical system, small technology providers have to adapt and integrate their solution. This adds significant cost and complexity to each implementation and limits the company's ability to expand and scale their solution to other similar cities and communities.

SynchroniCity – a three-year large-scale pilot, funded primarily by the European Commission – has helped define and validate a framework that lowers these barriers. Rather than creating new technology, SynchroniCity employed the 'minimal interoperability mechanisms' (MIMs), developed and supported by the Open & Agile Smart Cities (**OASC**) community. These outline the minimum technical requirements needed for technology providers to interface their IoT solutions with local authorities' digital systems.

The interoperability of these mechanisms enables impactful IoT solutions to be easily deployed and replicated in any local authority experiencing the same challenges.

If adopted across Europe and beyond, the SynchroniCity framework could set the foundations for a new digital single market, where local authorities and technology providers of all sizes can easily exchange data and digital goods and services in a fair data economy.

With this digital market in place, local authorities will have access to a catalogue of digital services, allowing them to easily test and procure the best solutions for their citizens' needs and place demands on the market based on their strategic goals.

Small technology providers will have access to a much larger customer base to sell to and, with the right licensing agreements in place, IoT infrastructure and data could be bought and sold in a safe and secure way.

But the benefits of this digital single market will only be realised if the minimal interoperability mechanisms are adopted at scale. For this to happen, national governments must prioritise the digital transformation of local authorities and create an environment that rewards participation and minimises innovation risks. Funding, policies, legal frameworks and licensing models must also be in place to increase market confidence and trust between buyers and sellers. But most importantly, to have the greatest impact we must ensure that this digital transformation is defined in human terms. Without input from the people who experience our cities and communities every day, the services deployed to meet their needs – digital or otherwise – will always be lacking. Collaboration with citizens must be embedded in the design and deployment of the SynchroniCity framework to impact real-world problems.

National governments around the world are testing and launching similar frameworks to kickstart their digital economies. Let's make sure Europe is equipped and confident in participating in this global market and that our local authorities are at the forefront of digital innovation – leading the way in creating the most sustainable, prosperous and inclusive spaces for people.

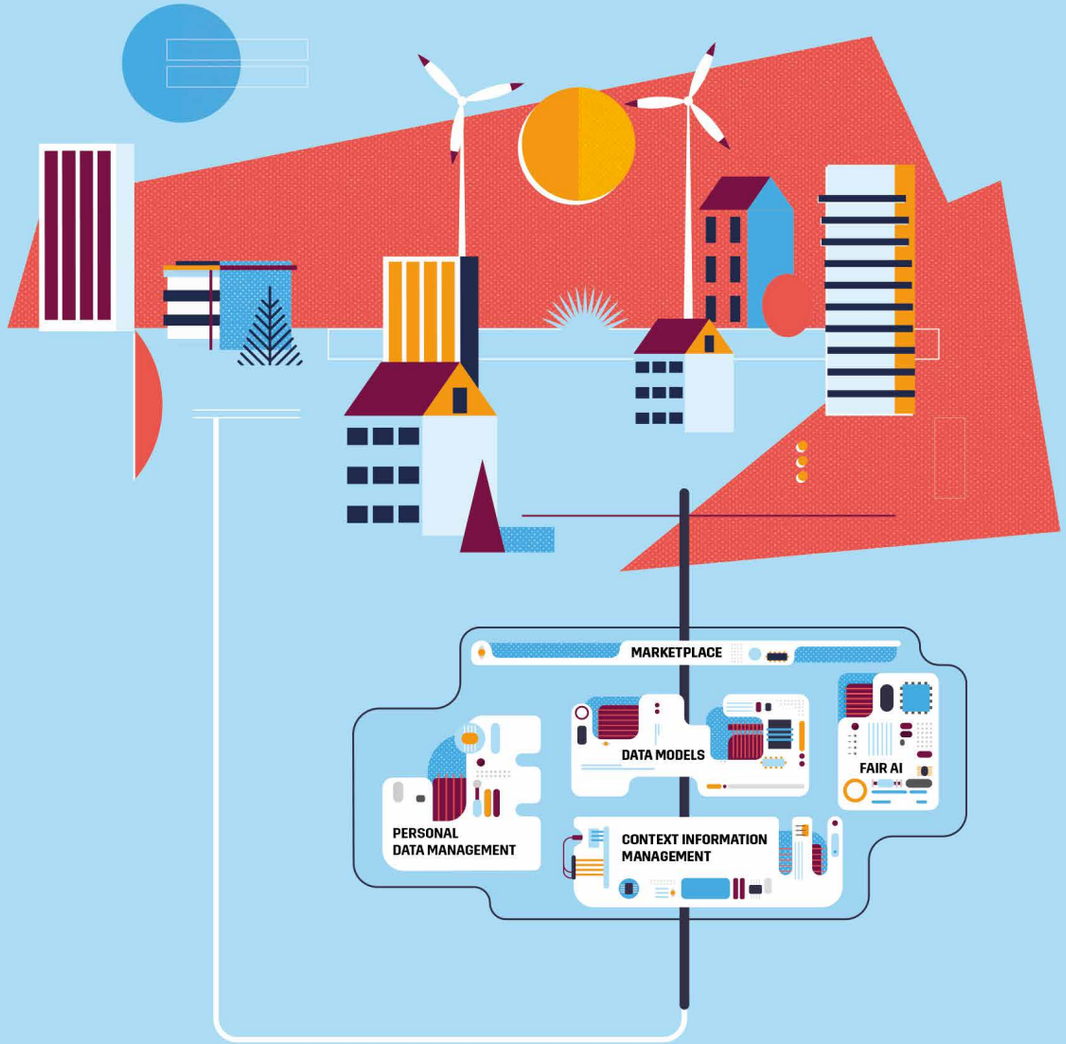
We can't be sure what challenges and opportunities the digital revolution will bring, but by establishing open, connected, and flexible foundations for our public services, we give ourselves the best chance of adapting to, and benefitting from, the latest digital innovations when they arrive; so when flying taxis do takeoff, we'll be ready. ■

“SynchroniCity shows how trust is developing between cities and SMEs, as well as trustworthy sharing of data.”

Martin Brynskov, Project Co-ordinator

What is SynchroniCity?

A universal approach to procuring and deploying IoT- and AI-enabled solutions

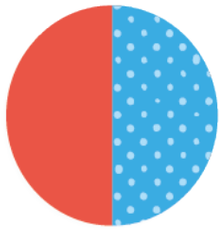


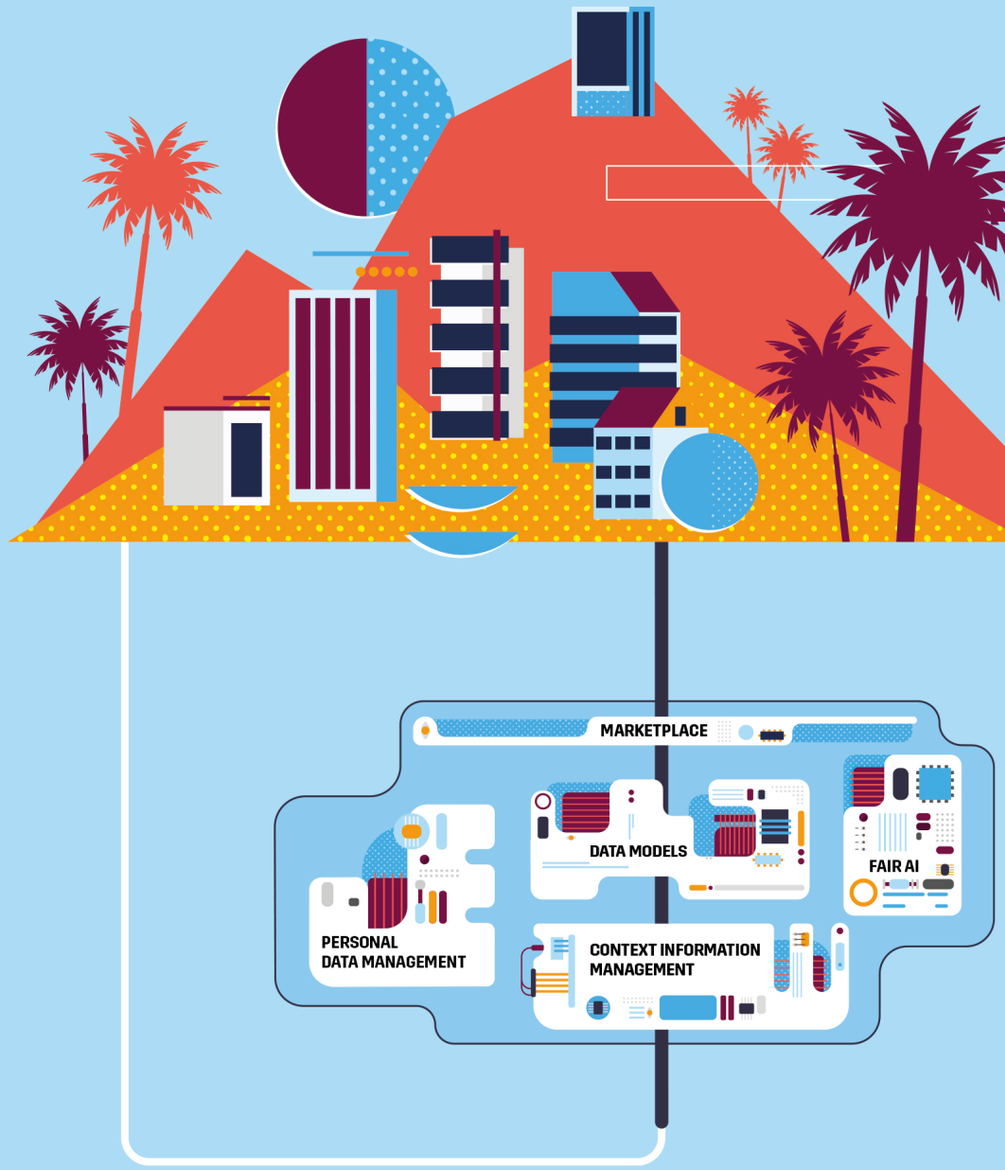
The SynchroniCity framework

This set of technical mechanisms enables local authorities and technology providers to easily exchange digital products, services and data.

The framework is built around the OASC ‘minimal interoperability mechanisms’ (MIMs), which when combined provide the technical foundation for procurement and deployment of IoT- and AI-enabled services for cities and communities. The MIMs are vendor-neutral and technology-agnostic and can be integrated with existing systems. The implementation of the MIMs can vary, but every technical architecture must use the same crucial interoperability mechanisms.

Any local authority or technology provider that adopts or becomes compliant with the MIMs will have access to a digital single market with standardised interfaces, common **data models** and new opportunities for local and global marketplaces.



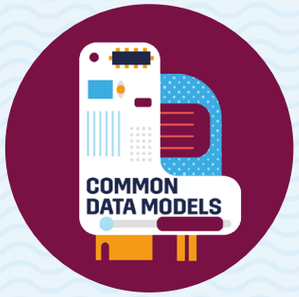


What are the MIMs?

There are currently three OASC MIMs:

CONTEXT INFORMATION MANAGEMENT

The Context Information Management (CIM) MIM provides access, use, sharing and management of structured data, or **context entities**. This is a central component of the framework, as it ensures data coming from different data providers is accessible and usable for all possible data consumers. The CIM component manages all interactions with stored and live data through a set of **APIs**, essentially forming the nucleus of the SynchroniCity framework.



COMMON DATA MODELS

This set of models describes generic entities and their related attributes based on the CIM data model. Such Common Data Models provide an essential element in the common technical ground by making replicability and portability across different cities and communities possible.

ECOSYSTEM TRANSACTION MANAGEMENT OR ‘MARKETPLACE’

The Marketplace provides a hub for the exchange of digital assets between data suppliers and data consumers within the SynchroniCity ecosystem. Data can be managed and potentially monetised through a set of APIs. The marketplace will have features to manage asset catalogues, orders and revenue management. These functions will support the creation of innovative business models.

There are currently two new proposed MIMs

These have been proposed to the OASC Council of Cities:

PERSONAL DATA MANAGEMENT

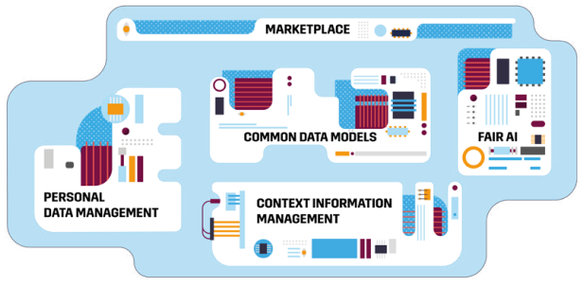
Personal data management is essential for delivering trustworthy services by local authorities, and also to guarantee that citizens maintain control throughout the data life-cycle and across systems. The Personal Data Management MIM ensures portability and other capabilities based on MyData and other leading initiatives.

FAIR ARTIFICIAL INTELLIGENCE

As machine learning and automated decision-making becomes increasingly common in digital public service delivery, there is a need for transparency and accountability. The Fair AI MIM provides basic inspection capabilities in any system which can be used both in procurement and in operations.

The MIMs are constantly evolving

During the SynchroniCity project, two additional core components were tested. These were *Security* and *Data Storage*, and it was identified that these two components are essential to the SynchroniCity framework. The Security component provides data security, privacy, and governance around the three main resources which form the basis of the services in the city – data, IoT infrastructure and platform services. The Security component enforces authentication, authorisation, and identification, protecting data in the SynchroniCity framework whilst ensuring fair and open access.



The Data Storage component provides access to both open and historical data. Open data is imported from various sources and harmonised with the SynchroniCity models. Historical data from the registered context entities is stored and accessed through the CIM component. The storage of data allows for the creation of new datasets.

The SynchroniCity project

The SynchroniCity project was a European Union Horizon 2020 research and innovation project, which ran from 2017-2019. It brought together citizens and 34 partners from academia, government, and business in 21 cities. The project developed and validated the SynchroniCity framework based on the OASC MIMs. The framework was piloted at scale in multiple cities around the world, where a variety of IoT services were deployed – demonstrating that a multi-vendor ecosystem is achievable. This laid the foundations for a digital single market for IoT- and AI-enabled services across Europe and beyond.

During the process of development, implementation, and deployment, we learned many lessons. The project addressed how to incentivise companies and citizens to actively participate, how to find common **co-created** IoT solutions for cities, which meet constantly evolving citizen needs and create an environment of evidence-based solutions that can easily be replicated in other regions.

THE SYNCHRONICITY PARTNERS

- Aarhus University – co-ordinator **(Denmark)**
- Aalto University **(Finland)**
- Alexandra Institute **(Denmark)**
- Forum Virium Helsinki **(Finland)**
- Engineering Ingegneria Informatica SpA **(Italy)**
- Atos **(Spain)**
- Associação Porto Digital **(Portugal)**
- University of Cantabria **(Spain)**
- Santander City Council **(Spain)**
- TST Sistemas **(Spain)**
- Future Cities Catapult **(UK)***
- Manchester City Council **(UK)**
- Digital Catapult **(UK)**
- Manchester Metropolitan University **(UK)**
- Comune di Milano **(Italy)**
- Imec **(Belgium)**
- Stad Antwerpen **(Belgium)**
- Rombit **(Belgium)**
- Hejmans Wegen BV **(Netherlands)**
- Ubiwhere **(Portugal)**
- European Network of Living Labs **(Belgium)**
- Bronze Software Labs **(UK)**
- City of Eindhoven **(Netherlands)**
- Mandat International **(Switzerland)**
- City of Carouge **(Switzerland)**
- UDG Alliance **(Switzerland)**
- Korea Electronics Technology Institute **(South Korea)**
- HOP Ubiquitous **(Spain)**
- NEC Laboratories Europe **(Germany)**
- Ulike **(South Korea)**
- Seongnam Industry Promotion Agency **(South Korea)**
- FIWARE Foundation **(Germany)**
- City of Bordeaux **(France)**
- Open & Agile Smart Cities **(Belgium)**

* Now Connected Places Catapult

The SynchroniCity pilots

The project involved a total of 50 deployments of products and services across 21 cities. These were broken down into pilots, which were SME-led groups, with between one to six organisations working on the deployment of their solution within the group and also worked closely with the SynchroniCity cities they deployed in. They focused on **citizen engagement**, environment and wellbeing, and sustainable mobility. Both small and large businesses with successful business models were chosen to deploy their digital solutions across digital markets throughout Europe and beyond. The pilots demonstrated that by using this framework, it is possible to transfer social and environmental impact to local economic activity, as well as opening new market opportunities for both local authorities and technology service providers.

CITIZEN ENGAGEMENT

Neighbourly™: A Smart City Platform
A smart city platform that shows the impact of waste production and recycling on a city's environment, at the level of each neighbourhood.
Companies: WasteHero, Everimpact, Zerocycle

ENVIRONMENT AND WELLBEING

Autonomous Real-Time Field Service Solution for Public Real Estate Air Quality Management
A full-cycle solution to enhance air quality in public premises and buildings.
Companies: Multi-Agent Technology Ltd, Metosin Ltd, City of Tampere

Clean Air School Districts
Uses environment sensors in schools to understand and solve the problem of poor indoor climate in classrooms.
Companies: Leapcraft ApS

NoiseAbility
Demonstrates that cities can holistically incorporate noise measurement into their management of urban spaces for improving liveability.
Companies: UrbanTide Ltd, The Lunar Works Ltd, City of Bilbao – Bilbao TIK, City of Edinburgh Council

SmartImpact
Provides IoT enabled service to manage the impact of urban development projects and public city activities by providing impartial evidence, real-time feedback and engagement between **stakeholders**.
Companies: DNET Labs, PUC Informatika, ORBIWISE SA, ALU MARKOM COM

RainBrain
Self-sustaining green roofs, which can also adapt to help mitigate flooding by optimising the water availability in and around green roofs.
Companies: Sumaqua bvba, Greenbeat, Agilis AS

SUSTAINABLE MOBILITY

Active Travel Insights
Provides a detailed understanding of cyclist, pedestrian and vehicle movements through the amalgamation of open, real-time and cutting-edge data.
Companies: Vivacity Labs Ltd, iSensing Ltd, Tracsis Traffic Data Ltd

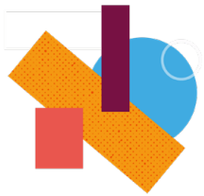
Autonomous Hub for Cyclist
An app-based solution to develop a network of safe parking for residents, which facilitates mobility by private bicycle storage throughout the city.
Companies: Intelligent Parking S.L., La factoría Bike-In S.L., TuryBike Emotion S.L., City La Nucía Municipality, Eurovelo, City of Donegal

Encouraging Cycling through use of Crowdsourced Data-Driven Insights
Providing cities with new, crowdsourced mobility insights into travel patterns and the use of city infrastructure with the overarching aim of encouraging growth in active travel.
Companies: See.Sense (Limeforge Ltd), BT, Dublin City

Kimap-City
Removes the information barriers around accessibility on public transport by providing citizens with detailed accessibility maps, so they can better plan their movements.
Companies: Kinoa s.r.l., ReteSviluppo s.c.

Kissmybike
A solution for cities and micromobility operators, that improves city transportation based on tracking data collected from bicycles.
Companies: KMB Lab srl, Actum4 Innovation SL

Real-time traffic data with energy savings on street lights
Leverages real-time traffic data to provide added-value services in the fields of adaptive lighting, environmental monitoring, traffic optimisation, and public safety.
Companies: SixSq, Schréder S.A.



OPEN CHALLENGE

ASAP-VALUE: A Standards-based Approach to enhancing VALUE from city data lake
A data lake converging city data from different sources and exposing it to application developers through a standardised API to encourage application proliferation for Smart Cities.
Companies: Sensinov

STANDARDS

What are standards?

The success of a digital single market is underpinned by the ability for a seamless flow of goods across borders. To enable this, you need common rules and agreed ways of working, including standards, which are simply defined as an agreed way of doing things.

The European Commission has identified standardisation as a key building block in creating a digital single market. Standards are important, as they ensure that a product made in one place, such as an electrical appliance, also works in the next. For consumers, standards provide protection by ensuring that products comply with minimum safety and performance requirements. For digital products and services, standards provide the process by which specifications are set, so that devices, systems, services and processes can connect and interoperate with each other.

For technology services providers, this means that instead of having to provide many different products to meet different specifications, you can instead align with common standards, allowing repeatable use of your product and providing significant economies of scale. Standards are also there to define what good looks like, helping you demonstrate how you align with best practice.

For local authorities, the use of common standards allows you to set a common baseline for technology providers, opening up the market to a much wider range of products and services, which align with best practice. As a result of these common requirements, it is easier for suppliers to scale, resulting in more choice, comparability, replicability, and overall efficiency and value for money for local authorities.

BlueAlpaca
A conversational information service (chatbot) that enables rich interactions between the public administration and its citizens and makes information and smart city services easily access ible.
Companies: U-Hopper srl

Linc
An IoT device that performs real-time analysis of electricity consumption buildings – down to individual appliances to identify inefficient operations, malfunctioning equipment, optimal tariff plans, and the integration of renewable generation.
Companies: Linc Systems ApS

Quamtra Smart Waste Management
An IoT technology to optimise current EU waste management operational methodologies based on the fill level of containers and bins
Companies: Wellness Telecom, SL, Ayuntamiento de Calatayud

RAIN BRAIN

Where the IoT solution was deployed

Antwerp and Eindhoven.

Aims of the pilot

Green roofs are an important climate adaptation tool for cities. They manage rainwater, reduce floods, increase biodiversity and clean the air. However, extreme temperatures and long periods of drought can have a devastating impact on the vegetation of green roofs, limiting the positive impact that they can generate. RainBrain aimed to create self-sustaining green roofs that can also adapt to help mitigate flooding.

IoT solution

RainBrain combines data from sensors and actuators with open data and predictive models to monitor and respond to the health and watering needs of vegetation on green roofs.

Impact achieved

- The solution was deployed and tested in two cities.
- 11 IoT devices were deployed.
- 1,847 datasets were consumed.
- 105,127 new datasets were generated.
- The pilot included a diverse range of partners, such as local authorities, citizens, universities, research labs, architects and green experts.
- The Technology Readiness Level of the team's IoT solution improved from 6 to 7.
- The team reported that the SynchroniCity technical framework significantly improved their service.

Lessons learned

Running user validation from the start and iterating during the process was key to developing a service that met the needs of the client and identified new business opportunities.

Advice to a technology provider deploying IoT

Use reliable and tested hardware to enable quick deployment and scaling, as failing hardware can significantly delay the entire growth and development process. Also, make sure to identify local actors that can assist in hardware maintenance.

ACTIVE TRAVEL INSIGHTS

Where the IoT solution was deployed

Antwerp , Helsinki and Manchester.

Aims of the pilot

Active Travel Insights aimed to provide a detailed understanding of cyclist, pedestrian and vehicle movements across a city using open, real-time and cutting-edge data to promote non-motorised transport across Europe.

The IoT solution

The solution combines data feeds from three types of sensors, with comparative open-air quality data provided by local authorities. All of these data were centralised in a dashboard.

Impact achieved

- The solution was deployed with sensors and dashboards in three cities.
- 42 IoT devices were deployed.
- 98 existing IoT devices were connected.
- 111 datasets were consumed.
- 613 new datasets were generated.
- 158 open datasets were produced.
- The Technology Readiness Level of the team's IoT solution improved from 6 to 8.

Lessons learned

Data Protection Impact Assessments, which address data privacy concerns, should be carried out before agreeing which cities to deploy in.

Advice to a technology provider deploying IoT: Ask local authorities to conduct site surveys early in the process to ensure that suitable locations, which meet the technology's specific requirements, are identified.

NOISEABILITY

Where the IoT solution was deployed

Bilbao, Edinburgh and Eindhoven.

Aims of the pilot

NoiseAbility aimed to provide local authorities with a predictive noise service tool to map noise levels in their city and understand what citizens perceive as an acceptable level of noise. They hoped that this would enable local authorities to holistically incorporate noise measurement into the management of their urban spaces.

The IoT solution

NoiseAbility developed a predictive tool for noise planning, which combines noise monitoring information with a city's strategic objectives and citizen-centric data via a data integration platform.

Impact achieved

- The solution was deployed in three cities.
- 19 devices were deployed.
- Millions of rows of noise level data were created and processed for AI.
- 4,000 data points were collected during the city and citizen engagement process.
- The Technology Readiness Level of the team's IoT solution improved from 6 to 9.
- The team plans to implement the solution in another two new cities in 2020.

Lessons learned

Innovative SMEs may be developing technical solutions for which there are no existing formal standards, so close collaboration between standards bodies and SMEs is essential.

Advice to a technology provider deploying IoT

Flexibility is key to making IoT deployments a success. This includes the approach, technical solutions, resourcing and, critically, flexibility in the funding structure, as contingency will always be required to manage unexpected issues. Regular face-to-face meetings between SMEs and local authorities are also crucial for cutting through on issues and for buy-in across city teams.

What next?

The SynchroniCity project has shown us that it is possible to create a sustainable and innovative ecosystem for IoT services within cities and communities based on the OASC MIMs. But it will only be made possible with more cities adopting the MIMs, more technology providers developing useful products and services, and with the support of national and international policymakers and regulators. With this in place, we can achieve the SynchroniCity vision, and set the foundations for a new, fair digital single market.

To make real change, we all need to act together, from all sides of the market: buyers, sellers and regulators. If our efforts are aligned and synchronised, then we can extend what SynchroniCity has achieved and start to shape the digital single market.

The journey is shared. But we all have individual roles to play. On page 32 the shared journey outlines the collective story. If you would like a run-down of the steps required for local authorities, see page 36. To see more detail about the story for technology providers, see page 46. Finally, see page 56 to read the call-to-action for national and international policymakers and regulators.

WHAT NEXT?

Embrace **Enable** **Cultivate** **Support** **Share**

NATIONAL GOVERNMENT
Creating the conditions for success

DOING THE RIGHT THING **DOING THE THING RIGHT**

UNDERSTAND **DEVELOP** **IMPLEMENT** **SUSTAIN**

LOCAL AUTHORITY
Provide efficient and effective services to their citizens.

IDENTIFY STRATEGIC OBJECTIVES AND GOALS

HOW CAN SYNCHRONICITY SUPPORT YOUR STRATEGIC OBJECTIVES?

ARE YOU READY TO CHANGE?

TECH PROVIDERS
Understand the needs, develop and sell the right products and services into a global market.

IDENTIFY STRATEGIC OBJECTIVES AND GOALS

MOBILISE AND PARTNER

MAKE A PLAN

USE DATA EFFECTIVELY AND SAFELY

PREPARE FOR IMPACT ASSESSMENT

IMPLEMENT THE TECHNICAL FRAMEWORK

KICK-OFF ENGAGEMENT INITIATIVES

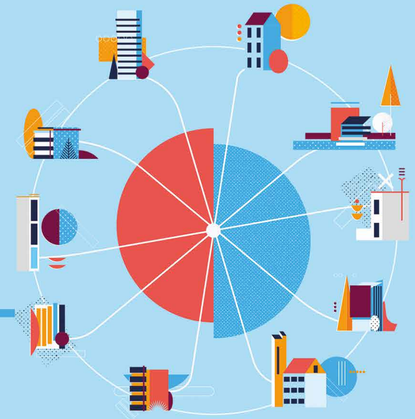
IMPACT ASSESSMENT

DEPLOY YOUR PRODUCT OR SERVICE

IMPACT ASSESSMENT

GROW THE MOVEMENT

CONTINUE ENGAGEMENT



Local authorities

In the following pages, you will find an outline of the journey for local authorities looking to adopt the MIMs. These steps offer guidance and considerations, with the hope that they encourage you to take the first steps towards engaging with OASC and adopting the MIMS.

A local authority's ability to deliver high quality services depends heavily on collaboration across a range of perspectives and skill sets. Strategy officers, procurement officers, IT engineers and legal advisors must all work together to inform and roll out these impactful public services. Yet each have their own departmental objectives, processes and terminology, causing significant inefficiencies in the implementation of new tools and services.

For the SynchroniCity framework to be implemented effectively, these departments must work together, break down the silos and find ways of communicating and learning with one another.

No matter how sophisticated a local authority's technical architecture is, it can be adapted to accommodate the MIMs – as they are by definition, the minimal requirements for interoperability. Whether a local authority has a complex network of sensors and smart devices, or none at all, the SynchroniCity approach has a lot to offer.

Benefits of the SynchroniCity framework

- Speeds up procurement
- Speeds up deployment
- Opens up new digital market and promotes innovation
- Enables validation of technology
- Reduces cost of IoT procurement
- Reduces vendor lock-in
- Helps identify problems
- Enables efficient tackling of problems
- Improves citizen engagement
- Improves citizen wellbeing

Local authorities have the opportunity to open up new local and global market opportunities, whilst improving the procurement and deployment processes of their IoT services. Enabling safe and fair access to data (see external resources on page 62) will stimulate innovation and allow local authorities to improve how they identify and tackle social and environmental issues. The SynchroniCity framework provides the technical foundations to easily procure and integrate young technologies, lowering risk for local authorities engaging with start-ups and innovators.

Local authorities who adopt the SynchroniCity framework will have access to IoT technologies that comply with the MIMs and which have already been validated and deployed across Europe. Once the framework is in place, the cost of IoT procurement and deployment will be reduced, as new technologies benefit from economies of scale.

The SynchroniCity framework reduces the reliance of local authorities on end-to-end solutions from large technology companies, reducing vendor lock-in. This means the public procurement process, which was previously dominated by large technology companies, is made more open and fair with SynchroniCity.

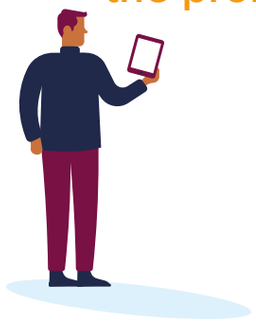
The framework is a way of future-proofing public digital services. By opening the door to start-ups and innovative new technology companies, local authorities can ensure the best services for citizens.

The more local authorities that adopt the MIMs, the more enticing this market will become to potential innovators, and the more opportunities we'll have to create sustainable, efficient and liveable cities for people.

• • •

"What makes data most useful is not having the most advanced technical capabilities but lowering institutional barriers and identifying the problems that data can address."

Ben Green, Author of Smart Enough City[1]



SYNCHRONICITY & STANDARDS

The SynchroniCity framework is based upon a core set of standards – the MIMs (see page 16). However, there is also a broader set of standards that are available that can allow you to refer to best practice that has already been agreed, rather than having to start from scratch.

You can look at standards as a set of tools, each of them having a different purpose. Therefore, to decide which standard you need to use, you need to first consider what it is you are trying to achieve. For example you might want to:

Define something: you might want to define a smart city or use common terminology so that suppliers have a common understanding of something and are referring to common terminology standards (eg ITU-T Y4051 defines common vocabulary for smart cities).

Understand something: you might want to understand what it means to be a smart city and refer to a guidance standard (eg PD8100 describes to city leaders what it means to be a smart city).

Design something: you might want to design a smart city platform or other components of an ICT system and reference an ICT Reference Architecture standard (eg ISO/IEC 30141:2018).

Manage something: you might want to set governance requirements for how data is managed (eg PAS183 provides a decision-making framework for sharing data in smart cities).

Measure something: you might want to set **KPIs** or use common approaches for how to measure performance and use a measurement or indicator standard (eg ISO 37122 defines indicators for smart cities).

There are many standards and many organisations that provide standards. Therefore, to help you identify standards, the SynchroniCity Standards Library has been produced to help you identify standards, categorising them into different themes and tagging based on different purposes.

How to implement the SynchroniCity framework

UNDERSTAND

Identify strategic objectives and goals

What are the most important economic, environmental and social needs of our citizens? What are your national targets/priorities?

How can SynchroniCity support your strategic objectives?

- Can SynchroniCity improve the quality of your service offer?
- How willing are you to innovate using open data, IoT and AI?
- How open are you to innovation? Do you have an innovation mindset?
- Is your culture flexible enough to accommodate new ideas?
- Do you understand the motivation for the MIMs and how they work?

Are you ready to change?

Is your technology ready?
Make an inventory of what technical assets you have and what needs to be developed. What is your current status with regards to: open data, sensors, IoT architectures and technical literacy?

Is your organisation ready?
Do you have the funding and skills to adapt your existing technology and adopt the MIMs?

Is your local ecosystem ready?
Consider holding 'kick-off' meetings with local technology providers to assess their interest.

DEVELOP

Make a plan

What are our objectives and expectations?

Define data handling
How will we handle ownership, service access terms and data licensing on existing and new IoT infrastructure? Consider developing your own data security and privacy guide document (see external resources on page 62).

Design a technical architecture
Create an outline for the technical architecture internally or working with an external provider, outlining how the MIMs interact with any existing infrastructure.

Understand what standards you are adhering to
What standards will we adhere to? Will we conform to smart city standards such as those proposed by OASC? Will we use software platform standards such as **FIWARE**?

Map expected impacts (with technology service providers and key stakeholders)
What are the expected positive and negative impacts of the technology services? Could there be any unintended consequences, particularly for vulnerable groups? Are citizens involved in co-creation? Is the technology service provider accountable for demonstrating impact?

Ensure you have flexible and open procurement models in place
Clearly describe your needs to the market. You may want to consider running an open call or pilot scheme to identify local challenges and procure young innovations.

Mobilise and partner

Partner with technology providers and wider ecosystem
- Agree on objectives and expectations
- Define standards to use
- Agree shared roles and responsibilities across the collaboration
- How is success measured?

Align with your objectives
How will we overcome the internal barriers identified in culture and skill set? Ensure internal alignment around digital transformation, and external alignment with smart city community.

Partner with the community
Identify how citizens can engage with the programme, and help co-create solutions.

Technical framework resource

The SynchroniCity framework is centred on three OASC MIMs (see page 16). Each of the MIMs play different roles in the framework and some are more important than others. The technical implementation of the framework can be broken down into five levels:

Level 0 – Initial Situation

- Current IoT infrastructure is provisioned entirely by a single vendor, built and maintained by the local authority or does not exist at all.
- Data is closed and specific.
- Innovation is stifled as the system is inflexible.

IoT infrastructure is either provisioned by a single external provider, built and maintained by the local authority or there is none at all. Data is self-contained and closed – proprietary data models restrict collaboration and growth. Although the IoT solutions employed might meet the specific current needs of the city, the system is inflexible and not set up to encourage innovation.

Level 1 – Entering SynchroniCity

- Identify current assets that would be compatible with the framework.
- Understand the SynchroniCity framework.
- Design a technical architecture.

The first step to entering the SynchroniCity ecosystem is to identify the assets that can be integrated into the SynchroniCity framework, such as existing IoT infrastructure and datasets. Start the process of development by designing a technical, interoperable architecture. The FIWARE catalogue, djane, scorpio, obelisk and OASC repositories provide some open source components that align with the MIMs (see external resources on page 62).

Level 2 – Initial Implementation

- Implement the CIM MIM (MIM1).
- Implement the security component.
- Implement the data storage component.
- Adapt existing interfaces to the SynchroniCity framework.

The CIM MIM facilitates real-time data provisioning, reading from either open data, IoT devices or historical data. This forms the central brain of the framework. The CIM component manages creation, reading, updating and deleting of data adhering to the NGSI meta model. ETSI Group Specification CIM 009 describes the CIM API (NGSI-LD) Specification. The security component facilitates authorisation, identification and authentication. This is in line with the **OAuth 2.0 protocol**. This is to allow fair and safe access to the data endpoints.

Adaptors and connectors must be created to connect existing interfaces to the CIM API. There are some existing connectors and guidance for creating new ones in the FIWARE catalogue.

Level 3 – Adopting the Data Models

- Adopt the OASC Data Models (MIM2)

The Data Model MIM ensures that context entities are represented consistently across different instances of the framework. Common data models are stored and maintained in the OASC data model repository. These data models relate to the NGSI meta data model and the FIWARE data models. The OASC data models are based upon:

- The IoT Big Data Harmonised Data Models developed by GSMA.
- The FIWARE Data Models developed by the FIWARE Community.
- The schema.org Data Models developed by the Browser and search engine communities.
- Ontologies promoted by the European standards community, particularly SAREF4Cities.

See external resources for all of the above on page 62.

Level 4 – Marketplace Participation

- Deploy or integrate with an instance of the Marketplace MIM (MIM3).
- Make open data available through the marketplace.

The Marketplace MIM completes the SynchroniCity puzzle. By deploying a customised, local instance of a marketplace, or by engaging with an existing decentralised marketplace, data can be shared, consumed and monetised in a safe and secure way. Marketplaces can take any form (with one example being the SynchroniCity IoT Data Marketplace, based on the FIWARE and TM-Forum Business API Ecosystem Framework, see external resources on page 62) as long as they conform to the MIMs. A fully functioning marketplace will need to manage the following: cataloguing, federation of catalogues, ordering, inventories, service license agreements, customer accounts, feedback, reputation and revenue. With all this in place, digital assets can be monetised across their whole life cycle.

IMPLEMENT

Implement the technical framework

See the technical framework resource.

Kick-off engagement initiatives

Launch open call for IoT solutions. Launch community engagement initiatives.

Procure and deploy solutions

Engage with technology providers to deploy IoT services

Work with technology providers to integrate their solution with the technical architecture.

Assess your impact

Track the impact you are achieving

Collect and analyse data to assess your impact, and adapt to maximise your impact.

SUSTAIN

Grow the movement

Share your learnings

Share learnings with wider OASC and smart city community. Communicate your impacts and achievements.

Spread the word

Be an ambassador for the OASC movement. Sign the LIVING-IN.EU Declaration (see external resources on page 62).

Continue engagement

Maintain your services

Stay up to date and reflect on the impacts and results of deployment. Make sure continued support is in place.

Contribute to the technical community

Stay in touch with technical developments – such as new standards, data models and MIMs. Contribute to the community – develop and evolve existing technical assets.

"Gathering and opening up data is essential for improving decision making."

City of Porto

Technology Providers

Technology is being used to solve problems and improve lives across the world, and a diverse range of solutions and innovations already exist. This technology is evolving at a blistering pace, but the institutions and organisations that govern our cities and communities do not have easy access to these cutting-edge products and services. It is essential that technology providers developing hardware, software and data-driven services are given the opportunity to tackle local and global social and environmental issues.

Local authorities across the world are joining together to future-proof their IoT services by adopting the OASC MIMs. Technology providers can do the same by engaging with these communities and incorporating the agreed standards and mechanisms into their designs.

There is not a single prescribed way of taking advantage of the MIMs. For example, exploiting newly opened datasets to develop applications, collecting new data using sensors and distributing them through the marketplace, along with many more possibilities. The MIMs lay the foundation for innovation and opportunity. In the following pages, you will find an outline of the journey for technology providers looking to take advantage of the MIMs. These steps offer guidance and considerations, with the hope that they encourage you to take the first steps towards engaging with SynchroniCity.

Benefits of the SynchroniCity framework

Provides access to new market of buyers

Enables easier integration of digital technologies

Provides a platform for scaling

Provides a platform for validation

Enables access to new datasets

Removes need for full-stack solution

With the SynchroniCity framework in place, technology providers will gain access to a new market. It will be easier for smaller technology companies to access public procurement opportunities. Additionally, products and services that are developed to be compatible with the SynchroniCity framework will be connected to a wider ecosystem of SynchroniCity cities, avoiding 'city lock-in' – where products and services are specifically designed for a single city's technical architecture, which often requires costly customisation in order to integrate with different cities.

The SynchroniCity framework provides a platform for technologies to be validated. Once validated in a single city, the SynchroniCity market provides exposure and strength to the technology, creating an environment that improves scalability. Marketplaces offering hardware, software, and data through the SynchroniCity framework will also allow new technologies access to the city market, without requiring full-stack solutions.

How to adopt the MIMs

UNDERSTAND

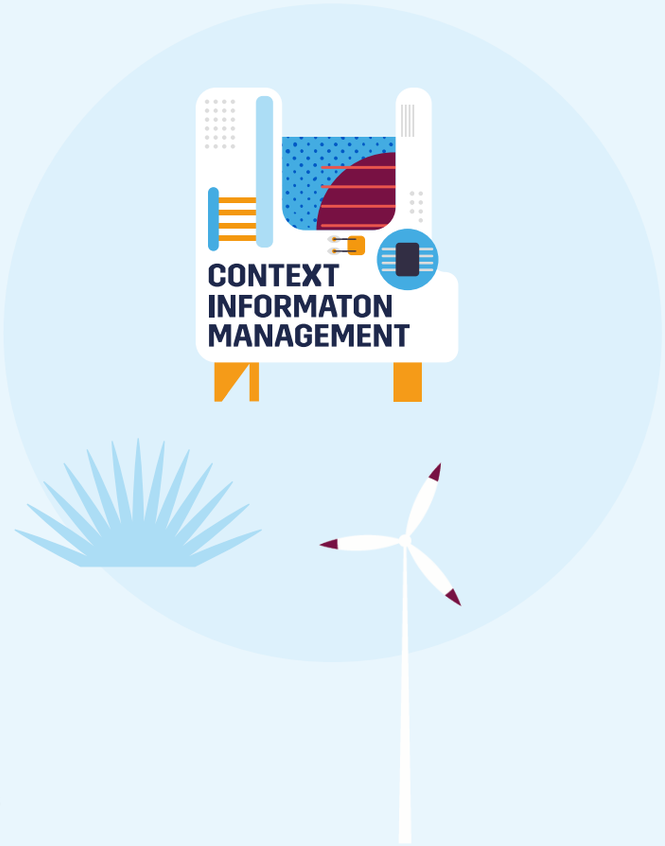
Is SynchroniCity right for you?

Align vision and objectives with SynchroniCity
Review your organisational aims and objectives, assess whether these will be made easier to meet by engaging with SynchroniCity.

Understand local authorities' challenges
Familiarise yourself with the strategic goals of local authorities. Is my product or service relevant to cities and communities? Is my product or service relevant to one specific local authority, or is it more widely applicable?

Understand the SynchroniCity framework
Do you understand the MIMs and how you fit into the SynchroniCity technical framework?

Review compatibility with the MIMs
Identify how your product or service interfaces with the MIMs. Identify useful existing technical resources that will aid in developing connectors and adaptors.



DEVELOP

Mobilise and partner

Develop city proposal
Detail which cities or communities to approach. Identify other technology providers you might want to collaborate with in order to provide a complete offer to meet the city's challenge.

Partner with local authorities and potentially other partners (national government, EU bodies or other organisations)
Agree on objectives and expectations. Define standards to use. Agree shared roles and responsibilities across the collaboration. How are we measuring success?

Work collaboratively to identify how to integrate any new devices with the technical framework
Who will be creating adaptors and connectors to ensure interoperability with the technical framework? If they already exist, identify how they can be used as part of the city's technical architecture.

Use data effectively and safely

Identify datasets
Which datasets will be brought onto the SynchroniCity marketplace? Identify which datasets you will create and which datasets you will consume. Are they already available? Are they open or do they need to be opened?

Data handling
Agree on the handling of ownership, service access terms and data licensing on any new data being collected, and existing data being used.

Data models
Review the OASC data models (see external resources on page 62). Identify which data models to use or develop new ones using the OASC framework.

Prepare for impact assessment

Map expected impacts with local authority and key stakeholders
What are the expected positive and negative impacts of your technology service? Could there be any unintended consequences? Who are the most vulnerable groups? What is the baseline? Can we prove and improve the effectiveness of our solution?

Prepare impact measurement
What will the research design be? What metrics will we measure? What datasets do we need and over what timeframe?

IMPLEMENT

Launch your product or service

Adapt and implement components
Implement connectors and data models to integrate your data with the SynchroniCity framework.

Integrate with the marketplace
Make your data available through the marketplace API. Publish your service licence agreements. Purchase and utilise datasets through the marketplace.

Launch
Roll out your product or service.

Assess your impact

Measure your impacts
What economic, environmental and social benefits are attributable to your implementations? Analyse your impact data and compare to your initial predictions and goals.

SUSTAIN

Grow the movement

Expand and scale
Once validated in a single city, expand to new cities. Maintain and scale your products and services responsibly and sustainably.

Share your learnings
Share learnings with wider SynchroniCity and smart city community. Communicate your impacts and achievements.

Continue engagement

Evolve your product and service
Stay up to date and reflect on impacts and results of deployment. Evolve your product or service in response to feedback and analysis.

Contribute to the technical community
Stay in touch with technical developments – such as new standards, data models and MIMs. Contribute to the community – develop and evolve existing technical assets.

“For a successful digital transformation, the needs of citizens are key.”

Zsuszanna Bodi, ENoLL

IMPACT ASSESSMENT RESOURCE

Impact assessment measures the short- to long-term outcomes of a particular deployment or solution, using economic, environmental and social metrics. This provides an evidence base for IoT and AI innovation deployments, improving services, enhancing local authority and investor confidence and increasing citizen engagement. The impact assessment process enables both technology providers and local authorities to overcome industry barriers, address societal problems and meet long-term objectives.

Recommendations for technology service providers:

- Start your impact assessment activities at the beginning of the project's conceptual phase. Early involvement maximises the chances of identifying the full range of impacts, supporting better baseline data collection and informing better pilot and deployment design.
- Gain a clear understanding of the local authority's needs and how your service addresses them.
- Engage the local authority and other stakeholders in 'impact mapping' to identify the biggest drivers of your solution's intended societal impacts. Logic models are an effective visual tool for this stage.
- Research recent academic literature to capitalise on learnings that will complement your solution (eg the effectiveness of mobility interventions can be improved with recommendations from behaviour change theory).
- Apply a scientific research design to your deployment in order to report with confidence on how much change can be attributed to your service.
- Report findings in comparable units and timeframes where possible, to aid municipal decision-makers with objectivity and consistency.
- Record, report and share results with stakeholders, clearly presenting positive and negative impacts and identifying stakeholders who suffer disproportionate negative or positive impacts.

For further guidance on appraising and evaluating projects, and discounting benefits over time, see *HM Treasury Green Book* (see external resources on page 62).

For further guidance on attribution, see *Small Slices of A Bigger Pie* by New Economics Foundation (see external resources on page 62).

ECONOMIC IMPACTS

Capital costs
Tax revenues
Economic growth
Employment
Efficiencies
Property values
Travel time savings
Productivity

ENVIRONMENTAL IMPACTS

Carbon
Air quality
Water quality
Resource depletion
Biodiversity
Green space
Waste
Noise

SOCIAL IMPACTS

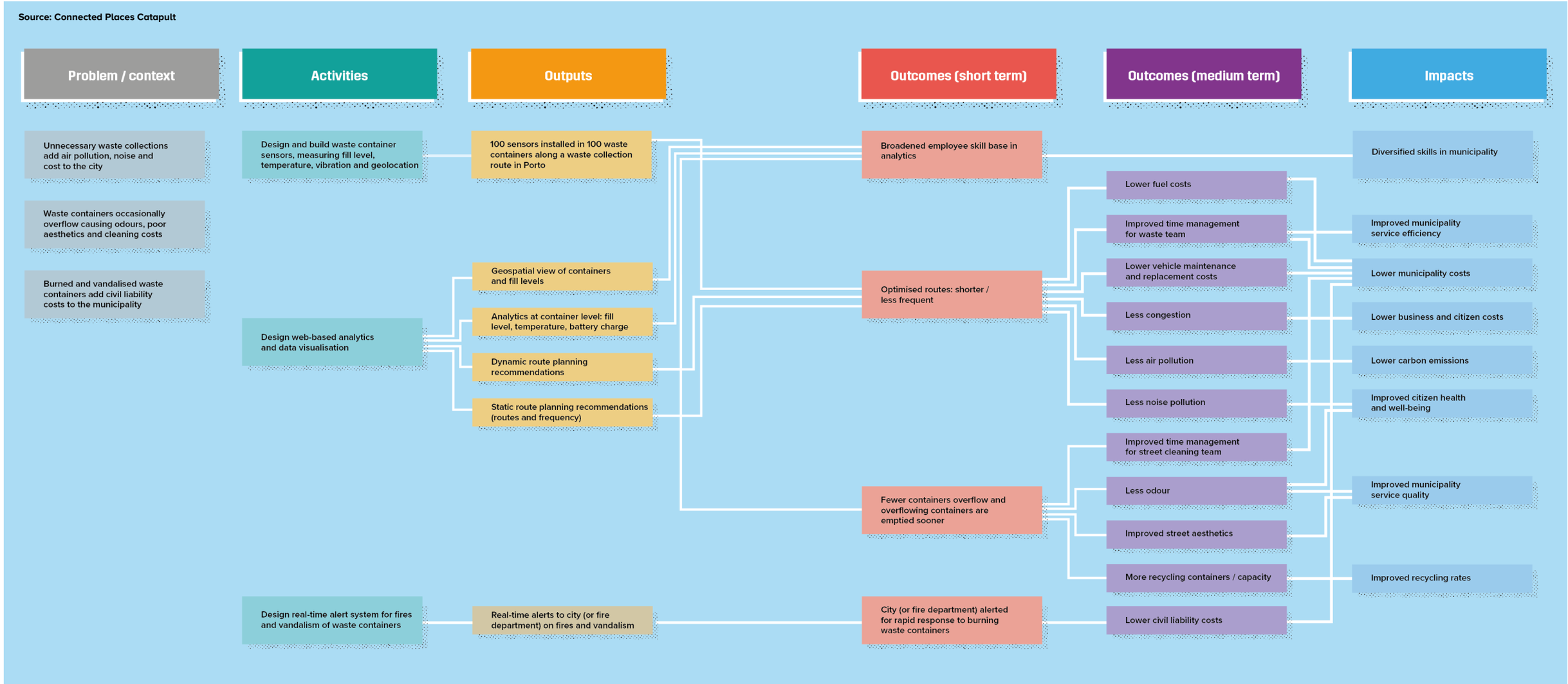
Health
Wellbeing
Relationships
Education & skills
Citizen engagement
Personal finance
Crime & safety
Job satisfaction

WHAT NEXT?

Example impact assessment logic model

Quamtra Smart Waste Management, SynchroniCity

Source: Connected Places Catapult



National and international regulators and policymakers

Regulators and policymakers play a key role in setting and implementing the legal and policy framework for sustainable economies and societies, and in creating the conditions for the effective delivery of public services for all. With a variety of challenges, such as digital transformation, energy poverty, environmental degradation and climate change, the status quo of how problems can be solved is no longer an effective means for the public sector to deliver on government and citizen needs and expectations.

Innovation provides a way for public sector bodies to identify more novel approaches to solve these problems. One particular area which provides many opportunities for innovation is around the effective use of IoT and data-driven solutions in cities and communities. The development of a flourishing IoT market also presents a significant opportunity for Europe to compete in the global digital economy.

However, an effective IoT marketplace, will not develop on its own. In fact quite the opposite, without intervention from regulators and policymakers, to create the right conditions, we could see, and have been seeing a highly fragmented marketplace develop with solutions that are not interoperable, failing to meet the needs of the public sector and citizens.

This is why frameworks like SynchroniCity are so important in defining the mechanisms that are essential for an effective and fair marketplace.

Creating the conditions for success

The OECD Declaration on Public Sector Innovation (see external resources on page 62) – adopted on 22 May 2019 by 35 member countries – positions innovation as a core and strategic function of public sector organisations. This declaration includes a set of five high level principles in order to embrace, enable, cultivate, support and share innovation.

Based on these principles, there are five ways in which regulators and policymakers can also support SynchroniCity as an enabler for IoT innovation.

EMBRACE

Embrace the OASC framework as a means of creating an effective marketplace for IoT products and services. Draw attention to it, promote it and ensure the right policy and regulatory framework is in place to support it, such as promoting the adoption of the MIMs and signing the LIVING-IN.EU Declaration.

ENABLE

Enable local authorities to use the SynchroniCity framework by ensuring that supporting structures, processes, working conditions and funding are in place to allow local authorities to more easily innovate with IoT and adopt SynchroniCity.

Encourage and support the adoption of innovative procurement processes such as pre-commercial procurement and the Innovation Partnership Procedure to enable the procurement of IoT enabled products and services.

Give permission for the public sector to take risks so that they can explore new ideas and ways of working that are unlocked by IoT enabled services as part of their core business. Understand and recognise the constraints (skills, resources, procurement, political will, etc) faced by local authorities in adopting innovation.

CULTIVATE

Connect different actors from across the public, private and not-for-profit sectors in ways that allow public sector organisations to partner, collaborate and co-create IoT products and services. The friction to these processes is reduced using mechanisms such as the MIMs.

Create partnerships across the ecosystem to cultivate sharing and exchange of information to increase capacity to innovate and benefit from SynchroniCity.

Develop a spectrum of engagement and co-creation.

SUPPORT

Support a culture of exploration, iteration and testing in the development of new solutions with public sector bodies, recognising that often experimentation and innovation may not only be about fixing, but also about learning.

Ensure there are effective mechanisms to engage with SMEs to reduce barriers so that they can benefit from SynchroniCity.

Support developing business cases for IoT products and services to scale responsibly and sustainably.

SHARE

Systematically share learnings from across the ecosystem, foster networking and learning to help public sector institutions learn from each other.

Establish good evaluation practices, in order to learn from and steer the innovation process. Identify further interventions needed to support the SynchroniCity movement and to help establish an effective IoT innovation ecosystem.

Develop and sustain feedback loops that capture feedback from citizens and public sector bodies.

“SynchroniCity addressed one crucial challenge: how can IoT and AI technologies underpin massive political and financial commitments to solving societal issues if they can’t be implemented in a complex reality? Using the needs of cities and communities as a guide, the OASC Minimal Interoperability Mechanisms have now been shown to concretely deliver a market at scale – cities are coming together and companies are ready to provide. National and international leaders and regulators can – and *must* – now pursue this path to a prosperous, sustainable and inclusive future for everyone.”

Martin Brynskov, project co-ordinator

This is not the end

A digital single market fosters innovation, improving local authority service efficiency and accelerating the pace at which nation states reach their policy goals, whether in air quality, carbon emissions, citizen health, education or beyond. National governments, the EU and member state regulators and policymakers play a crucial role in enabling this innovation by creating the structures that will direct the flow of investment, funding, talent, information and entrepreneurship. These structures include policies, regulations, funding programmes and more. These tools play a critical role in informing the strategies and direction of local authorities and businesses.

Aligning those structures with the values and standards of SynchroniCity creates the foundations for digital transformation in your nation and across the world. Policies will inform local authority priorities and procurement processes; regulations will guide the direction of commercial and municipal activity; funding programmes will stimulate reward-seeking market activity and grant innovators vital access to finance – all directing local level activities and outcomes towards the safe and secure digital transformation that SynchroniCity embodies.

GLOSSARY

TERM	DEFINITION
AI	Artificial Intelligence (AI) describes computer systems able to perform tasks normally requiring human intelligence, such as visual perception, natural language processing and manipulation.
API	An Application Programming Interface (API) is an interface or communication protocol between different parts of a computer program intended to simplify the implementation and maintenance of software.
Co-creation	An effective process to generate ideas by sharing knowledge and experiences, connecting products and services to the real users. A co-creation process requires these steps to be implemented: definition of the objectives, co-design of services and products, co-production phase for refining the outcomes and identifying requirements, co-evaluation of the solutions, co-implementation for an actual use of the products and services and for generating the first results.
Context Entity	A context entity is a representation of a physical thing and its associated contextual information.
Data Model	A framework for representing things digitally.
EIP-SCC	The European Innovation Partnership on Smart Cities and Communities (EIP-SCC) is a major market-changing undertaking supported by the European Commission bringing together cities, industries, SMEs, investors, researchers and other smart city actors.
Empowerment	The process of concretely enabling citizens to act as first actors of the smart cities by sharing their data with city governments for the explicit purpose of improving governmental infrastructures and services, thus collaborating in the whole co-creation lifecycle and producing a relevant impact on driving smart cities' sustainability.
Engagement	The process of involving citizens in governmental practices, mainly for providing feedback to the governments about services and products and to influence policy making decisions.
ENoLL	The European Network of Living Labs (ENoLL) is the international federation of benchmarked Living Labs in Europe and worldwide.

TERM	DEFINITION
FIWARE	FIWARE is an open source initiative defining a universal set of standards for context data management which facilitate the development of smart solutions.
IoT	The Internet of Things is made up of devices – from simple sensors to smartphones and wearables – connected to the internet and communicating with each other.
KPI	Key Performance Indicators (KPIs) are measurements that aid evaluation of a project's success or progress towards an intended result.
Living Lab	An open and trusted environment for implementing real-life experimentation processes where stakeholders co-create innovative products and services.
MIM	Minimal Interoperability Mechanisms (MIMs) are universal tools for achieving interoperability of data, systems, and services between cities and suppliers around the world.
NGSI	Next Generation Service Interface (NGSI) is an API protocol developed by OMA to manage context information.
OASC	Open & Agile Smart Cities (OASC) is a non-profit, international smart city network that has the goal of creating and shaping the nascent global smart city data and services market.
OAuth 2.0	OAuth 2.0 is the industry-standard protocol for authorization.
Open call	An invitation to the market for applications towards meeting a specified objective or overcoming a specified challenge.
SME	Small-to-Medium Enterprise.
Software repository	A software repository, or "repo" for short, is a storage location where software packages are stored and retrieved.
Stakeholder	Any individual or group who has an interest in the outcome of an action provided by an organisation or a company.
TM Forum	TM Forum is a global industry association for service providers and their suppliers in the telecommunications industry.

EXTERNAL RESOURCES & REFERENCES

External Resources

Djane
https://www.djane.io/

Ellen McArthur and IDEO Circular Design Guide
https://www.circulardesignguide.com/methods

ETSI Group Specification CIM 009
https://www.etsi.org/deliver/etsi_gs/CIM/001_099/009/01.02.01_60/gs_CIM009v010201p.pdf

Future Cities Catapult City Data Sharing Toolkit
https://futurecities.catapult.org.uk/wp-content/uploads/2018/10/City-Data-Sharing-Toolkit_V1.1_FCC_Oct2018.pdf

FIWARE and TM-Forum Business API Ecosystem Framework
https://business-api-ecosystem.readthedocs.io/en/latest/

FIWARE Catalogue
https://www.fiware.org/developers/catalogue/

FIWARE data models
https://github.com/FIWARE/data-models

GSMA data models
https://www.gsma.com/iot/wp-content/uploads/2018/07/CLP.26-v5.0.pdf

HM Treasury Green Book
https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-governent

LIVING-IN.EU Declaration
https://living-in.eu/declaration

LOTI city tools – dashboard
https://app.powerbi.comview?r=eyJrIjoiMjBmY2EzNDEtMmEwNy00NjkyLTkxZDAtMmQ3YTFlOTdlYmU1liwidCI6IjVjOTA3MDE5LTI5ODktNDQ4OC04NmNmLWZlNWRlYmMwN2ZjMyIsImMiOjh9

LOTI city tools – report
https://www.bbhub.io/dotorg/sites/33/2019/11/CityTools_London.pdf

U4IoT Data Protection Game
https://u4iot.eu/privacy-game.html

U4IoT Data Protection Game e-course
https://u4iot.eu/e-course4.html

U4IoT end user engagement toolkit
https://u4iot.eu/end-user-engagement-toolkit.html

OASC data models
https://gitlab.com/synchronicity-iot/synchronicity-data-models
https://theodi.org/article/data-ethics-canvas

OAuth 2.0 protocol
https://oauth.net/2/

Obelisk
https://obelisk.ilabt.imec.be/api/v1/client-docs/

ODI Data Ethics Canvas
https://theodi.org/article/data-ethics-canvas

OECD Declaration on Public Sector
https://one.oecd.org/document/C/MIN%282019%296/FINAL/en/pdf

SAREF4Cities
https://www.etsi.org/deliver/etsi_ts/103400_103499/10341004/01.01.01_60/ts_10341004v010101p.pdf

Schema.org
http://schema.org/

Scorpio
https://github.com/ScorpioBroker/ScorpioBroker

Small Slices of A Bigger Pie, by New Economics Foundation
https://neweconomics.org/uploads/files/86c098b42b969e12c6_wam6i8ux8.pdf

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https://iot-data-marketplace.com/

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Retrieved on 18th December 2019

SYNCHRONICITY

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SYNCHRONICITY

Please don't leave this guide on a coffee table. Please open it. Please read it, ask questions and start conversations with those around you. Please build upon it and call others to action. SynchroniCity is just the beginning of a movement to empower those who govern our cities and communities to make the places where we spend our lives work well. Let's contribute to this ecosystem and create a level playing field for new ideas and innovation to thrive.