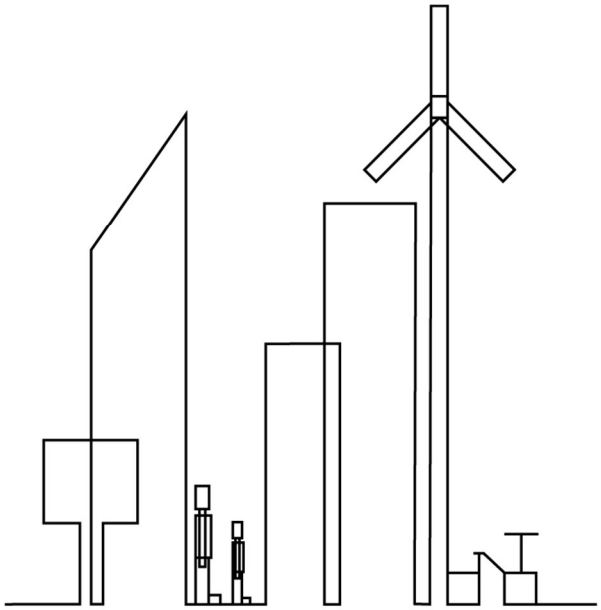

URBAN
CO-CREATION
DATA LAB

Handbook for Smart Cities Co-Creation Labs

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1 Executive Summary

This handbook provides a wrap-up important level-document with recommendations for future work on smart cities services and use cases based on the work developed in the project Urban Co-Creation Data Lab. It provides an overview on open data local issues, differences in use cases, and possibilities for new services. For the possible new services are addressed the relevant markets, is made a market analysis, and are described the essential requirements to guarantee business sustainability.

2 Future work on smart cities services and use cases

The definition of services and use cases in the context of smart cities is of extreme importance to cope with necessities that cities have in the management of the several verticals of a city. In the context of Urban Co-Creation Data Lab project were addressed and defined the services and use cases considering:

1) **Mobility**
    a. Micromobility: predictive model of bike docks occupation for a bike sharing service, considering weather and business days and weekends. The model will allow to predict bike docks occupation in periods of 3 hours during a week, providing relevant information for bike rebalancing operations. The outputs provided by the model will also be relevant for the planning of the bike stations network expansion.
    b. Parking: identification of patterns and risk of illegal parking in the city of Lisbon, at street level and time of day. The model will be based on the illegal parking occurrences registered by the Municipality Police of Lisbon. The proximity to services will also be included in the model, namely the proximity to schools, and health facilities. This service will be used to optimize the dispatch of police officers for areas with more risk of parking illegalities.
2) **Environment**
    a. Waste management: predictive model of mixed waste production considering weeks with holidays. The predictive model will allow to predict mixed waste production for a set of mixed waste collection circuits weekly during a month. The model will allow to optimize the number of trucks needed to collect waste in each circuit, as it will be able to provide information about the expected mixed waste production for a specific mixed waste collection circuit.
    b. Pollution; models of atmospheric (natural gas) and liquid pollutants (nitrobenzene) propagation at city micro-scale, with a 1 to 15 minutes temporal resolution will be developed. The models will be developed using buildings 3D geometry, weather data, terrain, and the physical characteristics of the pollutants. This service will allow to the civil protection services, isolate the areas that are more vulnerable to the pollution clouds, allowing to manage the city areas that must be isolated, for protection of people and goods.
3) **Quality of life**
    a. Emergency: identification of traffic accidents risk at street level. This prediction model will be deployed in PGIL, where it will provide, the streets and periods of the day in which there is a higher risk of traffic accidents. This service will be used by the emergency services to optimize the location of emergency vehicles in the proximity of streets with more risk of traffic accidents. This will allow the reduction of the response time to traffic accidents.

For the definition of use cases and services in the context of smart cities is essential to understand the needs of the different city services.

2.1 Open data local issues

Open data used in the project was retrieved from the Lisbon Open Data Portal. However, from the relevant datasets used in each use case, just the one used for micromobility (i.e., with information about the number of empty docks and occupation ratio) was openly available. Open data used was for providing context to the analytical models developed, do not having a temporal component (i.e., most of the open data available do not have a temporal component, presenting just the spatial location of the respective dataset).

Indeed, this is a limitation that must be considered, as datasets with temporal component besides their spatial one, can be relevant for the development of better predictive models. Besides that, the absence of temporal component of most open datasets available conditioned the modelling approaches for the development of the services and use cases. As examples for the development of the micromobility and waste production model resorted to time-series models in which was just integrated one more dataset besides the relevant ones (i.e., the bike docks occupation ratio and waste production for the micromobility and waste management use cases, respectively. Also, for the development of the parking and emergency use cases, the absence of this temporal component in the datasets, resulted in the development of simulation models and not predictive models.

In a near future this absence of open datasets available with a temporal component could decrease as for example in Portugal on the 14th of July 2021 meeting of the Commission for Constitutional Matters, Rights, Liberties and Warranties, the Directive (EU) 2019/1024 of the European Parliament and Council from 20 June 2019, regarding open data and reuse of information in the public sector, was transposed to the Portuguese national law. This directive it incorporates further measures to mitigate emerging barriers of access to public sector data while harnessing the rapid changes in digital technologies, namely providing data access in real time via sufficient technical infrastructure.

It establishes also that dynamic data (digital documents subject to frequent or real-time updates, such as sensor acquired data in the environmental, traffic, satellite, or weather fields) should be made immediately available upon collection or changes (in the case of manual updates) via an API (Application Programming Interface) or block download.

The directive also refers the importance of public data for a variety of users, namely in the development of new services and applications, resorting to openly available high value datasets (i.e., geospatial data; earth and environment observation data; weather data; statistical data; data regarding companies and companies' property; and mobility data).

2.2 Differences in use cases

Each city has their social and economic context, resulting in differences in the use cases that can be developed for each. These differences are augmented if the use cases defined for a city are extended to a broader geographic area i.e., a region. Indeed, this aspect increase the complexity and the challenge of model's reutilization that have been developed for a city.

2.2.1 Waste management

Waste management use cases for a city where the goal is to estimate the production of waste within the city can be extended to regions in which the definition of the use case is the same.

However, in the case of a region waste collection is made in several villages of that region. The total predicted amount of waste collected it refers to more than one village. Despite the application of the developed model at city level can be directly applied to a region, this aspect raises some questions regarding their direct application. For example, the auxiliary variables (i.e., the impact factors) that affect waste production can vary from village to village and inside the specific region. These characteristics must be considered at the modelling phase, in which the waste collected in a set of waste collection circuits (i.e., for a set of villages) can have different explanatory variables, depending on separate locations of the region.

2.3 Possibilities for new services

2.3.1 Micromobility

i. Prediction of bike docks demand in periods of 3 months for each bike station: the objective of this service is to understand the bike stations that register a higher or lower demand to support the plans for the expansion of bike stations network.
ii. Impact assessment of COVID-19 pandemic in mobility and environment: the objective of this service is to provide information about the effects of the pandemic in the use change of traditional transportation means to soft mobility.
iii. Assessment of services accessible in 15 minutes by bike: this service will provide information about the accessible services from a certain location reachable in a 15-minute bike ride. The service can be used by the city services for planning purposes and by citizens to identify for example areas of the city that have more accessible services.
iv. Calculation of intermodal itineraries: this service allows to calculate the best routes accordingly with the availability of public docks and the integration with other public transportation means.

2.3.2 Waste management

i. Prediction of mixed and recycled waste for the following year for each one of the macro territorial intervention units: the objective of this service is to allow to the urban hygiene department to plan a year ahead the acquisition of waste collection trucks and the human resources needed for the collection of waste in the city for the following year.
ii. Prediction of waste collected in sensing waste bins: the objective of this service is to understand and predict the dynamics associated with the production and collection of waste, to optimize waste collecting schedules allowing waste collection route optimization
iii. Identification of waste deposited outside waste bins, using video analytics: the objective of this service is to identify problematic areas regarding waste deposition, to assist urban hygiene departments in waste collection operations.
iv. Identification of the best location for waste bins: the objective of this service is to identify the best locations of waste bins, to avoid overflown bins in residential areas.

2.3.3 Parking

i. Information system for identification of available parking lots: this service has the objective to provide an app that can be used by citizens to search for available parking lots. This will allow the reduction of time citizens are looking for available parking lots, decreasing traffic congestion and reducing pollution.

ii. Taxation of private parking: this service will allow to quantify and control the taxes charged to city entities that have parking spots attributed by the city council.
iii. Calculation of parking prices accordingly with the demand: this service can optimize the income that cities earn from the parking spaces they manage, improving traffic conditions.
iv. Improvement of parking for multimodality: this service allows the optimization in which users park their vehicles for combination with other public transport systems (bus, subway, tram, or public bicycles).

2.3.4 Pollution

i. Model to describe and predict the environmental health and air quality: the objective of this service is to provide real time information and prediction of air quality parameters, evaluating the demographic profile of the population affected, resorting to descriptive and predictive panels to present the information.
ii. Noise maps: this service will allow the elaboration of dynamic noise maps to assess this type of pollution in the city for the different city managers

2.3.5 Emergency

i. Multi risk simulator: the objective of this service is to support several civil protection services (Events, Risk Analysis, Planning, Sensitization, Communication and Psychosocial Support to the Population) in management of several risks namely environmental, technological, and mixed. This simulator allows to identify the impact that a certain occurrence can have: 1) in the population affected; 2) affected area; 3) affected critical infrastructures; and 4) locate affected population clusters.
ii. Traffic accidents awareness and safety: cars involved in traffic accidents can share their location and status with authorities via public network, so emergency services can dispatch their means and other drivers can be aware of the danger to slowdown.

3 View business sustainability

3.1 Relevant markets

To assess the sustainability of new services is necessary to identify the relevant markets in which the new services are framed, namely:

- Mobility: micromobility services
- Parking: parking services
- City planning and management: waste management, pollution, and emergency services

3.1.1 Mobility

With the emergence of open data initiatives, there is immense potential to improve mobility. Open data, encourages transparency, participation, improved efficiencies and effectiveness of services and foster innovation and self-empowerment. Citizen-generated open data is the data that individuals consciously generate and that are openly available for use in the public domain. The promise of citizen-generated data is that it generates a basis for public governance. Moreover, citizen-generated data can provide better information for public governance also be used to challenge current positions and power structures. Most analyses of open data focus on the barriers for government to make data available and the extent to

which citizens and other stakeholders are using these data. When it comes to sharing and managing mobility data, the challenge cities and their private sector partners face is how to reconcile essential goals such as: Cities need access to data and information about how people move to develop and implement plans and policies that support positive outcomes for mobility and sustainability. Companies and vendors need data to operate their businesses, collect payments, and optimize services. At the same time, the ability of an individual to think and move freely, without fear of undue surveillance, is the foundation of democratic society; both the public and private sectors must ensure that the privacy of individual people remains protected.

The contribution of citizen-generated data to public governance should thus be included in terms of potential vertical application. In this plan, it is indicated that this type of open data can be understood from the perspective of public governance as a multi-actor process.

Principles for managing mobility data are given in below with the respect of the project results:

1. Cities require data from private vendors operating on city streets to ensure positive safety, equity, and mobility outcomes on streets and places in the public right-of way.
2. Cities should treat mobility data as they treat personally identifiable information (PII). It should be gathered, held, stored, and released in accordance with existing policies and practices for PII.
3. Cities should be clear about what they are aiming to evaluate when requiring data from private companies. This may include, but is not limited to, questions related to planning, analysis, oversight, and enforcement.
4. Cities should prioritize open data standards and open formats in procurement and development decisions. Data sharing agreements should allow cities to own, transform, and share data without restriction (so long as standards for data protection are met).

Thus, mobility for citizens is one of the main potential vertical applications in the project.

3.1.2 Parking

While the geolocations of numerous parking facilities are freely available, its raw data is not. The data is often embedded on a map within a mobile-unfriendly website, which cannot be used while driving. Open data related to parking can include basic information, GPS coordinates, services, payment methods, rates, schedules, availability of electric vehicle chargers, accessibility for persons with reduced mobility, and air quality information. There are some examples of parking such as: Saemes, the second largest parking provider in the Paris region, opened its Opendatasoft-powered open data portal dedicated to parking data back in March and has since unlocked the data on ninety parking facilities in the Paris region (that is 23 000 parking spaces). Moreover, In Lille, France, the metropolis partnered with Opendatasoft to aggregate and share data from Waze, bikeshare operators, and transit—data that an entrepreneur then used to create a free real-time parking availability app. In San Francisco, meanwhile, the Municipal Transportation Agency (MTA) has moved this year to demand-responsive pricing for the 28,000 spaces it manages after a successful pilot which saw average meter rates fall by 4% and time spent looking for a spot fall by thirty percentage points over control areas.

The creation of data repositories – loaded with **metadata**, images, video streams, audio capture, and more – will give users a service that is increasingly responsive to their needs. By opening these repositories in interoperable formats, such as **APIs**, operators will allow for the development of increasingly relevant applications.

As cities implement smart solutions to individual components of their transportation systems, it will be increasingly important to incorporate data sharing systems behind the scenes to integrate otherwise separate data sources and applications. An integrated approach will lead to innovative solutions for drivers—for example, parking operators are already thinking about partnering with third parties to guide drivers to lots with available spaces—but these solutions depend on a data infrastructure that can share several types of information and signals in real time.

3.1.3 City planning and management

Urban management efforts aim at solving the problems of cities and managing city systems also benefit from the explosion of new data environment formed by open urban data, which can serve as an important complement to conventional survey data and data collected by various administrative departments. Over the past decade, a plethora of new data sources has become available for urban management, opening many new possibilities to better monitor and understand urban settings.

To date most **air pollution** data has been derived from models based on data from a limited number of stationary monitoring sites combined with transportation, weather data, satellite imaging data and other open data sources to estimate pollution for various locations. To improve the accuracy of these models, more direct air quality data is needed. Now, gathering that data is becoming feasible. Low-cost portable sensing devices connected via Wi-Fi networks are available today at a fraction of the cost of conventional stationary systems, enabling localities to expand the number of monitoring points. At the upper end of the scale are sensors (often multi-purpose) that can be attached to lampposts, bus stops, buildings, utility poles and other fixtures. At the lower end are affordable personal sensor devices that enable residents and visitors to participate in gathering and sharing air quality data. These personal devices can be placed in homes or workplaces or carried as one walks or bikes to gather ambulatory measurements.

As cities grow, so does the amount of **waste** we produce. By 2050, the United Nations estimate that 68% of world population will live in urban areas and the World Bank that solid waste will increase by 70%. The inadequacy of existing trash containers and landfills may lead to the accumulation of garbage on city streets and to illegal dumping, with profound consequences for public health. Waste management is much more than just trash collection. It also entails the selection, control and distribution of bins, the planning of pick-up routes, the sorting of garbage, the monitoring of vehicles loads, bin and dump filling levels, as well as the instructions, billing models and incentive programs to encourage citizens to use bins properly. One of the greatest challenges for waste managers is that each trash container has different emptying requirements: a bin on main street may collect cans and tissues over an entire day, while bins in a back street a few steps away might be filled with restaurant food leftovers in just one evening. Another challenge is finding the most strategic locations for bins, to avoid overflown containers in residential areas and systematically empty disposal units in secondary roads. Data-driven IoT and AI applications can solve these problems. By placing Radio Frequency Identification (RFID) tags and internet-connected ultrasound sensors in bins, it is possible to collect data about the location, fill level, temperature and even type of waste of each trash container and communicate it to cloud-based data analytics platforms. Data can then be processed to derive useful insights, such as the most strategic bin locations, type, and size, as well as the optimal garbage collection routes, frequency, and vehicle loads. Data can also be used to automatize the sorting, compression, and vacuum collection of trash and even to personalize waste billing and issue vouchers based on the type and weight of waste.

Regarding **emergency**; while cities are locked down and borders are closed in response to the coronavirus outbreak, science is becoming more open. This openness is already making a difference to scientists' response to the virus and has the potential to change the world. The WHO and national organizations like the Chinese Centre for Disease Control and Prevention also publish open statistical data, such as the number of patients. This can help researchers to map the spread of the virus and offer the public up-to-date and transparent information.

3.2 Market analysis

Urban Co-Creation Data Lab results showed some additional applications on market such as: Mobility as a service, parking, and capacity building between related stakeholders on city planning & management systems.

Since the contribution of citizen-generated data to public governance should be included in terms of potential vertical application for city management, it is indicated that this type of open data can be understood from the perspective of public governance as a multi-actor process. As cities implement smart solutions to individual components of their transportation systems, it will be increasingly important to incorporate data sharing systems behind the scenes to integrate otherwise separate data sources and applications and accordingly Urban Co-Creation Data Lab provides new solutions for drivers - for example, parking operators are already thinking about partnering with third parties to guide drivers to lots with available spaces. Also, there is a gap between the types of technological solutions being proposed and whether these solutions, and the way they are being implemented, are necessarily promoting inclusivity, resilience, and sustainability from the perspective of economically and socially disadvantaged urban residents. Thus, the capacity building on smart city management is indicated in this plan as a critical vertical application. Regarding the key needs for the applications areas, according to the research performed and interviews, the best opportunities and demand are in the following:

- Mobility as a service e.g., parking – high demand from commuters/travellers, as well as from mobility Apps.
- City planning and management – high need from multiple public administration organization, as well as the private sector e.g., urban planners and architects.

These suggested application areas have been selected by making a large market analysis so that the project results can be best disseminated and applied in the most sustainable way. While the geolocations of parking facilities are freely available, its raw data is not and the data is often embedded on a map within a mobile-unfriendly website, which cannot be used while driving. For city planning and management, an increase of new data sources has become available for urban management, opening many new possibilities to better monitor and understand urban settings.

3.3 Requirements for business sustainability

Future sustainability depends on several aspects, such as:

1. Availability of frequently updated and diverse datasets;
2. Willingness to buy, or need for use, from a considerable number of users or organizations;
3. Viable business and/or funding models;
4. Availability of affordable IT infrastructure.

3.3.1 Availability of frequently updated and diverse datasets

The availability and their frequent update is essential to develop and maintain the services after deployment. This availability can be achieved on datasets available on open data portals, supporting applications and services developed by the public or private sector. The more relevant datasets available can potentiate the arising of more valuable applications and services. The frequently update of open datasets is essential for the development of services and applications as it guarantees the use of more updated datasets in their development. Also, the access to historical data is important to maintain services that are based on predictive models so they can be retrained if needed. Is also important that these open datasets are accessible via Application Programming Interface (API) to services be automatically updated with added information recorded in the source. Diverse datasets availability also plays a key role as it can increase the richness of the services and applications developed. However, the richness provided by diverse datasets can be amplified if these datasets vary in time and space and can be provided in almost real-time. This last aspect was discussed in section 2.1.

3.3.2 Willingness to buy

Considering the statistics on the total number of local self-government authorities there are some indicators that provide an overview of the potential for adoption of our services by this type of stakeholders. According to the Council of European Municipalities and Regions (CEMR), the number of Local Public Administrations (municipalities and other type of local authorities) in some of the largest countries in Europe are France - 36.658; Germany - 11.313; Ukraine - 10.855; Spain - 8.124; Italy - 8.006; UK - 419 (Local Authorities). Companies operating in mobility, environment services and energy industries can also benefit with knowledge and information that can improve their business strategies and decision-making processes. The supportive organizations/associations and Research/Scientific Organizations that targeted in the project are active in the field of environment, mobility, and energy. There are also several types of organizations active in the environmental, emergency and mobility/transportation areas, across Europe and some of them act at international level, other at local and/or regional level and since mobility and environment are interconnected domains, the project results can be of interest to any of these organizations as well.

3.3.3 Viable business and/or funding models

3.3.3.1 Viable business

Mobility: Urban areas need admittance to information and data concerning how individuals move to create and conduct plans and approaches that help positive results for portability and maintainability. Capacity of a person to think and move openly, unafraid of unjustifiable reconnaissance, is the underpinning of vote-based society; both the general population and restricted areas should guarantee that the security of distinctive individuals stays ensured. As urban areas execute shrewd answers for individual parts of their transportation frameworks, it will be progressively vital to fuse information sharing frameworks in the background to coordinate in any case separate information sources and applications. The open information development depends on the three standards of straightforwardness, investment, and cooperation. While it is accepted that through receptiveness, sharing and cooperating, the worth of information to society can be genuinely understood, the fast opening of government information has not been all around gladly received. The Open Mobility Foundation (OMF) stewards an open-source tool called “Mobility Data Specification” (MDS) that was initially developed by cities to help manage dock less micro-mobility programs (including shared dock less e-scooters). To support Mobility Data Specification (MDS) users in addressing

privacy concerns, the Open Mobility Foundation (OMF) has formulated comprehensive guidance for applying MDS in the context of GDPR in the European Union. The OMF supports and facilitates the development of open-source technology employed by cities and mobility services operators. opentransportdata.swiss is the customer information platform for Swiss public transport and individual mobility. Here you can view mobility data free of charge and access numerous services. The data published here has been prepared for developers. The platform provides timetable, real-time and actual data in a file- or service-based format. The data cover all licensed transport companies in Switzerland.

Parking: While the geolocations of numerous parking facilities are freely available, its raw data is not. The data is often embedded on a map within a mobile-unfriendly website, which cannot be used while driving. Open data related to parking can include basic information, GPS coordinates, services, payment methods, rates, schedules, availability of electric vehicle chargers, accessibility for persons with reduced mobility, and air quality information. With the Park Indigo application drivers can enter their destination and choose the nearest available parking location, which can also be saved as a favourite parking lot. AIPARK provides live parking assistance based on data from millions of connected vehicles. The system integrates with all internet-enabled platforms: connected cars, mobility apps and traffic management P-route is a Dutch application that shows users where they can park their bike in the city of Utrecht. Through the application, users can find up-to date information on space availability in bike parking facilities. In addition, the application shows information on distances to bike parking facilities and routes to get there. Saemes provides real-time parking information in Paris to allow drivers to save time and find their parking space swiftly. ParkingDD shows users the current parking situation in different European cities. Depending on the data, you will receive the current number of free public parking spaces and their locations. By visualizing where parking fines are handed out in Vantaa, car drivers know better where parking a car in the street is not allowed which will prevent people from being fined and will encourage them to use paid car parks instead.

City planning and management: The City of Toronto's Open Data Portal is an open-source delivery tool to bring people and data together. Port Moody's Open Data Portal gives access to data, statistics, and information about city government. By making data accessible, they aim to promote public collaboration, increase government transparency, and spark innovation. This information is used to inform local decision-making and will help for better plan. The City of Palo Alto Open Data Portal, first launched in 2012, includes over one hundred datasets and we are adding more all the time. For example, here you can find information about how the City of Palo Alto spends money; the status of development permits; geospatial data; historic library information; Utilities data; and current infrastructure issues. The City of Cambridge Open Data Program makes government data easily available in useful formats, and is intended to increase transparency, foster engagement among residents, and create new opportunities for collaboration between Cambridge and the public.

3.3.3.2 Funding models

There are several funding options that can be reached via Urban Co-Creation Data Lab's results. Joint Call for Proposals: Positive Energy Districts and Neighbourhoods for Climate Neutrality which is the call of the PED Programme facilitated by the JPI Urban Europe, aiming at supporting the large-scale implementation of at least 100 PEDs by 2025 and aims to continue creating a transdisciplinary and cross-sectoral community working in the field of the energy transition in the urban context, aiming for high stakeholder involvement, collaboration, and co-production of knowledge. EIT URBAN MOBILITY reflect pathways for cities to address the European Green Deal objectives for the transport sector of -55% CO_2 emissions by 2030 and -90% CO_2 emissions by 2050 compared to 1990 levels. The EIC Accelerator provides

grant-only support as well as support in the form of blended finance and supports high-risk, high-potential small and medium-sized innovative enterprises. INTERREG EUROPE supports regional and local governments across Europe to develop and deliver better policy. Call also creates opportunities for sharing solutions and policy learning and aims to make sure that government investment, innovation and implementation efforts all lead to integrated and sustainable impact for people and place. European Investment Project Portal (EIPP) applies throughout the financing cycle to the benefit of final beneficiaries and financial intermediaries and can deliver on EU policy objectives, minimise overlaps and ensure synergies. COSME reflects the Commission's political will to recognise the significant role of SMEs in the EU economy. COSME supports SMEs in the facilitating access to finance. EUROSTARS Eurostar's has been developed to answer to the specific needs of the R&D-performing SMEs, and targets the development of new products and services, giving easier access to international markets. GREEN DEAL transform the EU into resource-efficient and competitive economy, ensuring: no net emissions of greenhouse gases by 2050. Financial Support for Third Parties (FSTP) aims at simplifying the administrative procedures, creating a light, SME-friendly application scheme, by allowing that some EU-funded projects may issue, in turn, open calls for further funding. Digital Europe Programme for proposals for EU action grants in the field of Cloud, Data and Artificial Intelligence under the Digital Europe Programme (DIGITAL).

Public funding sources

Apart from that, specific funds might be available on national levels within programs that support business development and innovation provided to either private or public entities.

Urban Co-Creation Data Lab worked on establishing close interactions with municipalities, working groups and committees involved in similar or related activities in Europe including current European initiatives focused on urban data / urban analytics and other European funded actions working on similar perspectives.

Joint Call for Proposals: Positive Energy Districts and Neighbourhoods for Climate Neutrality

This call on Positive Energy Districts and Neighbourhoods (PEDs) is the second call of the PED Programme facilitated by the JPI Urban Europe, aiming at supporting the large-scale implementation of at least one hundred PEDs by 2025. It succeeds the PED Pilot Call and will find its continuation in the European partnership "Driving Urban Transitions to a Sustainable Future (DUT)." As an integral part of comprehensive sustainable urbanisation strategies, establishing Positive Energy Districts and Neighbourhoods shifts the focus from the individual positive energy building towards neighbourhoods and thus a new level of impact on sustainable urban development and the energy transition process. With this call, JPI Urban Europe aims to continue creating a transdisciplinary and cross-sectoral community working in the field of the energy transition in the urban context, aiming for high stakeholder involvement, collaboration, and co-production of knowledge.

EIT URBAN MOBILITY

EIT modelled three different transition scenarios to reflect pathways for cities to address the European Green Deal objectives for the transport sector of -55% CO_2 emissions by 2030 and -90% CO_2 emissions by 2050 compared to 1990 levels. These pathways are composed of a set of twenty-nine different policy measures (e.g., car and bike sharing, cycling infrastructure, subway, and bus lanes, etc.) grouped into three main scenarios:

"Promote and Regulate": this transition pathway assumes the promotion and regulation of nineteen sustainable mobility options;

"Plan and Build": this transition pathway focuses on fourteen infrastructure building and technology related actions;

"Mixed": this transition pathway is a mix of the two above-mentioned approaches, with twenty-three measures related to both technological innovations and behavioural change.

The EIC Accelerator

The EIC Accelerator Pilot builds on the SME Instrument Phase II and provides grant-only support as well as support in the form of blended finance (combining grant and equity). The scheme supports high-risk, high-potential small and medium-sized innovative enterprises willing to develop and commercialise new products, services and business models that could drive economic growth and shape new markets or disrupt existing ones in Europe and worldwide.

INTERREG EUROPE

Interreg Europe helps regional and local governments across Europe to develop and deliver better policy. Interreg creates an environment and opportunities for sharing solutions and policy learning and aims to make sure that government investment, innovation and implementation efforts all lead to integrated and sustainable impact for people and place. To achieve this goal, Interreg Europe offers opportunities for regional and local public authorities across Europe to share ideas and experience on public policy in practice, therefore improving strategies for their citizens and communities.

European Investment Project Portal (EIPP)

The Invest EU Fund combines thirteen centrally managed EU financial instruments and the European Fund for Strategic Investments into one instrument. Under the Invest EU Fund, there is a single fund with a strong financial capacity and a single set of coherent requirements, which applies throughout the financing cycle to the benefit of final beneficiaries and financial intermediaries. Thanks to its centralised nature, Invest EU can deliver on EU policy objectives, minimise overlaps and ensure synergies.

COSME

COSME is a programme implementing the Small Business Act (SBA) which reflects the Commission's political will to recognise the significant role of SMEs in the EU economy. COSME supports SMEs in the following areas: Facilitating access to finance, supporting internationalisation and access to markets, Creating an environment favourable to competitiveness.

EUREKA and EUROSTARS

Eurostar's is a European joint programme, co-funded from the national budgets of 36 EUREKA countries and by the European Union through Horizon 2020. Eurostar's has been carefully developed to answer to the specific needs of the R&D-performing SMEs, and targets the development of new products and services, giving easier access to international markets, thanks to the transnational nature of each project consortium. Eurostar's is a competitive programme that sees an average of 29% of project applications receive funding, meaning that submitting projects proposal is certainly worthwhile.

HORIZON EUROPE & GREEN DEAL

To overcome climate change and environmental degradation challenges, the European Green Deal transform the EU into a modern, resource-efficient, and competitive economy, ensuring: no net emissions of greenhouse gases by 2050, economic growth decoupled from resource use, no person and no place left behind. One third of the 1.8 trillion-euro investments from the Next Generation EU Recovery Plan, and the EU's seven-year budget will finance the European Green Deal.

Financial Support for Third Parties (FSTP)

Financial Support for Third Parties (FSTP) distributes public funding to assist beneficiaries, such as start-ups, scale-ups, SME and/or mid-caps, in the uptake or development of digital innovation. This funding method aims at simplifying the administrative procedures, creating a light, SME-friendly application scheme, by allowing that some EU-funded projects may issue, in turn, open calls for further funding.

Space (EC and ESA)

Within the Horizon Europe funding program and the European Space Agency initiatives there is simultaneously technical support and funds available.

Copernicus delivers accurate and reliable information in the field of environment and security and supports a wide range of Union policies in domains such as agriculture, environment, energy, health, civil protection, humanitarian aid and transport. Mainly tailored to the needs of public authorities, Copernicus also serves research, academic, commercial, and other private users. The system consists of three main components: a space component, which delivers data from a fleet of dedicated observation satellites (the 'Sentinels') and from contributing missions; and in-situ component which collects data acquired by a multitude of sensors at air-, sea- and ground-level; and a service component which transforms the wealth of satellite and in-situ data into timely and actionable information products. The programme is managed by the European Commission and implemented in partnership with the Member States, European Space Agency (ESA), European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT), European Centre for Medium-Range Weather Forecasts (ECMWF), EU Agencies and Mercator Ocean International. Galileo provides Europe and European citizens within dependence and sovereignty for the provision of location and navigation services. The Galileo system offers several high-performance services worldwide, featuring various levels of accuracy, robustness, authentication, and security:

- Open Service (OS): Galileo Full, Free and Open (FFO) service set up for positioning and timing services. The Galileo Open Service also provides Navigation Message Authentication (OSNMA), allowing the computation of the user position using authenticated data extracted from the navigation message.
- High Accuracy Service (HAS): A free access service complementing the OS by providing an additional navigation signal and added-value services in a different frequency band. HAS is intended to offer real-time user positioning performances with accuracy less than two decimetres in nominal conditions.
- Public Regulated Service (PRS): Service restricted to government-authorised users, for sensitive applications that require an important level of service continuity.
- Commercial Authentication Service (CAS): A service providing users with the capability to obtain an authenticated Galileo PVT solution.
- Search and Rescue Service (SAR): Europe's contribution to COSPAS-SARSAT, an international satellite-based search and rescue distress alert detection system.

The European Geostationary Navigation Overlay Service (EGNOS) is Europe's regional satellite-based augmentation system (SBAS) that is used to improve the performance of global navigation satellite systems (GNSSs), such as GPS and Galileo. EGNOS improves the accuracy and reliability of GNSS positioning information, while also providing a crucial integrity message regarding the continuity and availability of a signal. In addition, EGNOS also transmits an extremely accurate universal time signal. EGNOS delivers three core services:

- Open Service: free and open to the public, the Open Service is used by mass-market receivers and common user applications;
- Safety of Life Service (SoL): primarily geared towards civil aviation, the SoL service has potential applicability to a range of safety-critical transport applications which require enhanced and guaranteed performance and an integrity warning system, including maritime, rail and road;
- EGNOS Data Access Service (EDAS): offered on a controlled access basis, EDAS provides ground-based access to EGNOS data through the Internet to customers requiring enhanced performance for professional use.

Private investors, business angels, crowdsourcing

Funding via Angel and Private Investors: The typical angel investor is a high-net-worth individual who has an interest in helping new companies expand. These accredited investors provide start-ups with seed money in exchange for an equity stake in the company. There is a higher risk associated with angel investments as they are dealing with an unproven business model. It is also probable that the company does not have a product and, if they have customers, they might not have significant revenue. However, they are more forgiving on the types of metrics that VCs use to measure a potential investment.

Crowdfunding can be defined as an open appeal to the public to raise funds with a specific objective. The concept itself is far from new and has been embedded in human culture since its early days. Historically, people have been raising money to achieve certain objectives for the common good. Numerous examples of charitable donation campaigns can be found in early history, however, the term crowdfunding typically denotes raising funds using the Internet. The emergence of online crowdfunding dates to more than a decade ago, but the use of a dedicated platform for several crowdfunding campaigns has only gained traction in recent years. The development of entrepreneurship, the creation of start-ups and the growth of SMEs are considered important contributors to the economy in terms of innovation, competitiveness, employment, and growth. Crowdfunding contributes to this economic growth, by generating additional revenue for companies or by providing capital to start-ups and SMEs. In addition, the social network mechanism that powers crowdfunding platforms brings together market participants who, in an offline context, would not have the opportunity to meet.

3.3.4 Availability of IT infrastructure

The high availability of an IT infrastructure is essential, so services developed for the different city stakeholders can be operational without interruption for extended periods of time. Several decisions should be made for building a high availability system:

1. Eliminate single points of failure: remove any point in the system that could make the rest of the system fail;
2. Consistency and reliability balance: availability and consistency should be balanced for the servers that are used as backups and the downtime associated, and the time

which the service is available. The availability can change depending on the objective of the services or applications;

3. Multiple geographic zones: consider hosting the services in multiple geographic zones for better chance of maintain the services due an outage in a server;
4. Microservices: distribute several functions of the application or service into individual systems integrated between each other. However, microservices increase system complexity;
5. Data redundancy: the same should exist in several places, reducing the risk of losing data and guarantees data can be recovered;
6. Self-monitoring for failure: the system should contain mechanisms to manage failures and should be able to detect and fix them in short periods of time, maintaining the system running for longer time periods minimizing downtime.

To guarantee all or some of the above characteristics, there is the need to increase costs associated with the IT infrastructure, and this aspect should be considered in the acquisition of the IT infrastructure. There must be a compromise between the costs associated with the IT infrastructure considering the planned availability for a specific service or application.