Muntstroom PCP, Brussels Capital Region

Pre-Commercial Procurement (PCP) regarding
R&D of end-to-end solutions
for monitoring multi-faceted people flow

Market consultation document -

Annex 1: Scope of the project

Table of contents

1 Introduction

1.1 Objective of this document

As part of the Open Market Consultation and Open Client Dialogue, this document describes the scope of the Muntstroom PCP.

1.2 Reading guide

Chapter 2 describes the desired solution and output.

Chapters 3 to 5 describe the different elements that will be used to evaluate the initial offers of the technology suppliers and the outcomes of PCP-phase 1 (solution design) and PCP-phase 2 (prototype).

Chapter 6 describes PCP-phase 3 (Living Lab-phase), during which the developed prototypes from PCP-phase 3 will be tested in the real environment. To evaluate this phase, use-cases have been drawn up. These are elaborated in Annex 2 of the Market consultation document.

2 Desired solution and output

To shape the pedestrian monitoring system, the general idea is to design and test a system that is designed to 1) capture, 2) communicate, 3) store, 4) process 5) analyse and 6) provide smart access to people flow data. These aspects are visualised in Figure 1 and Figure 2 and are further elaborated in the following chapters.

The expected output of the desired system consists of

1) Visualisations of the People Flow-data
2) People Flow-data sets (Open Data and on-demand data sets)
3) Support for routing.

This under the following conditions:

a) Compliance with the sharing conditions of both public and private data sources
b) The output responds to the use cases
c) The system supports different business models
d) End-to-end compliance with the regulation on Data Protection
e) Different users can have different (levels of access to) information

Ad b) The uses cases are elaborated in Annex 2 of the Market consultation document.

Ad c) In the PCP we want to test this technology. Elaborating the business models themselves is NOT part of the project. Nor is the producing and/or selling of sets of data.

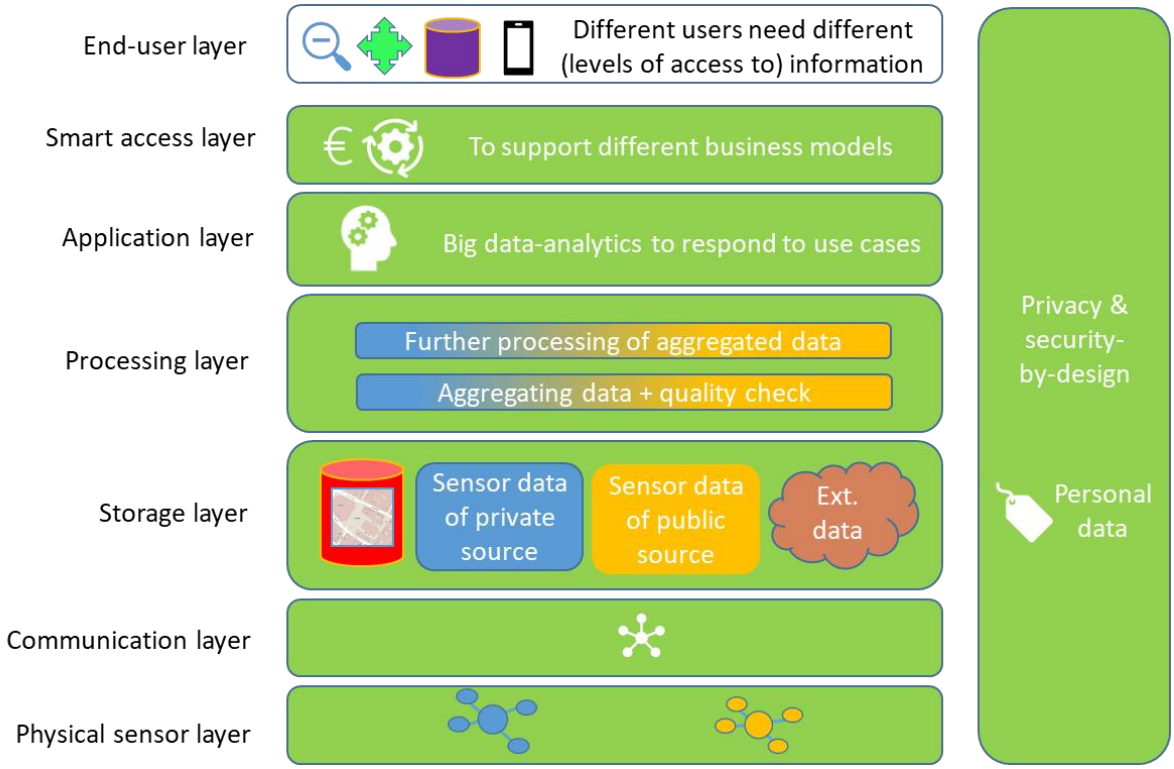


Figure 1: Data architecture of the desired solution

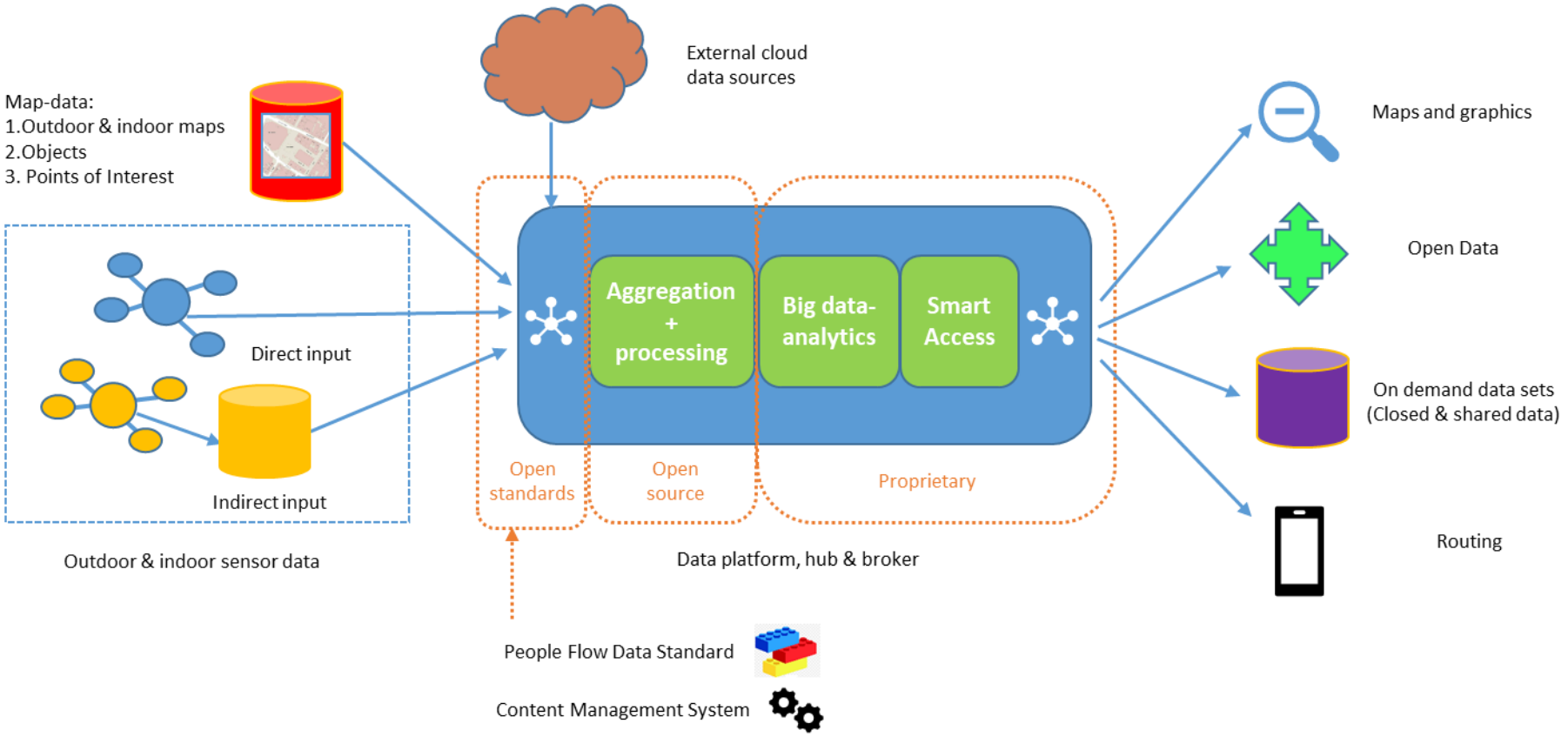


Figure 2: Visualisation of the desired solution

3 Description of the desired outcome of a technical solution

This chapter describes the desired outcome of the desired technical solution (end to end). The different architectural layers from Figure 1*Figure 1* are used as structure of the paragraphs.

3.1 Physical / input

3.1.1 Capture of People Flow-data

For the collection of People Flow-data, the PCP-suppliers are expected to provide, install and operate their own sensors (incl. beacons). It is up to the PCP-suppliers to define which technology/technologies they would like to use, to achieve to output-goals, as defined in this document.

NB 1. In this document the term “beacons” is used as a general term for positioning technologies. However, if PCP-suppliers want to use other technologies for the positioning, they are free to do so.

NB 2. To stimulate innovation the basic design principle is that *the intelligence and innovation need to be, in particular, in the platform and not in the sensors.*

3.1.2 Map-data

To tackle the use cases the following Map-data will be made available by the Muntstroom PCP Group and should be considered by the PCP-suppliers.

- Outdoor: UrbIS-data[1] is a set of cartographic and alphanumeric data specific to the Brussels-Capital Region.
- Indoor: the Muntstroom PCP Group intend to make available:
    - 3D-scans of the most important indoor areas.
    - information about the most important objects.
- A basic set of information about the most important Points of Interest (POI), such as important destinations and their opening hours.

The exact areas, objects, information and method of scanning are subject of discussion in relation to the use cases that the PCP-suppliers would like to elaborate.

3.1.3 Content Management System

To collect the basic information on the POI, the PCP-suppliers should provide a Content Management System (CMS). PCP-suppliers should at least integrate and present the provided POI-data and the provided list of objects. The market parties will be challenged to enrich the basic POI-data with external data.

The goal of the CMS is to support the information gathering for and by the local POI. And this from an evolving perspective. E.g. to use the Muntstroom solution during temporary events, also information about temporary objects should be able to be introduced or removed.

[1] https://bric.brussels/en/our-solutions/urbis-solutions

3.1.4 People Flow data standard

To shape the People Flow-data standard, the Muntstroom PCP Group prescribes certain metrics that are important to understanding of people flow, see Annex A and the output desires.

To develop the People Flow-data standard during the project, the market parties will be challenged to be actively involved with additional synchronization. During PCP-phase 3 (the Living Lab-phase) it needs to be tested if output desires can be achieved with the prescribed elements.

3.1.5 On and off mode

The system must be able, on the input side, to facilitate wishes from sensor-owners concerning the non-sharing or non-processing of sensor-data. E.g. no data capture between 9 and 10h.

3.2 Communication

3.2.1 Open standards

The Muntstroom PCP Group wants:

- that the output of different sensor technologies can be combined and analysed
- that the output different People Flow-related sensors could also be combined and analysed
- all systems to receive, understand and reutilise the sensor-data.
- to prevent that during PCP-phase 3 (living lab-phase) there are too many sensors placed at one place
- to prevent that sensors only work on one back end

For the communication of sensor-data the Muntstroom PCP Group therefore intends to mandate the use of open standards like:

- A standard for the sensor-data, micro- and metadata (People Flow data standard)
- Data exchange language (like xml)
- Open communication protocol for the exchange (like API)

3.3 Storage

3.3.1 Storing different data side-by-side

The system should be able to store different data side-by-side. For example, because of the conditions for (re)using “private” data[2] and the difference between personal and non- personal data.

3.3.2 Flexibility and future-proof

To support future data-sharing the data storage should be as flexible and future-proof as possible. This requires, for example, attention for the scalability, Total Cost of Ownership (TCO), interoperability and the usage of cloud-agnostic technologies.

[2] For example a sensor that is owned by a private / non-public commercial organisation that is sending data to the platform.

3.4 Processing: basic activities

3.4.1 General vision

The basic processing (combining sensor-data, quality check, …) should support the underlying vision.

The manager of a space is installing Muntstroom-sensors. The manager will be the owner of the collected data. The data is uploaded, directly or indirectly, to the Muntstroom solution. Because of this, the manager has access to his complete set of data, nicely visualised in maps and graphics. This is the first advantage of using the Muntstroom solution. For instance: the manager of the mobility hub De Brouckère can see how travellers move within the boundaries of the mobility hub. The data of different owners is then combined. By sharing its data, under certain conditions, the data owners together become the owners of the aggregated data. Together they will have a more complete view of the people flow. However, with less details. This is the second advantage of using the Muntstroom solution. For instance: Together the managers of the mobility hub and corridors can see how many travellers in general make use of their spaces. However, how persons exactly move *within* a space is restricted to the primary owner of the data.

Table 1: Vision about data ownership and advantages for the aligned partners

3.4.2 Open Source software

For the basic processing software needs to be developed. The Muntstroom PCP Group wants this software to be open source (OSS), so other contracting authorities can use, reuse and modify the software, in accordance with their needs. Additionally, OSS relies on open standards accessible to everyone, removing potential issues related to format incompatibility which may exist in proprietary software.

3.4.3 Data quality

This aspect is elaborated in § 5.9.

3.5 Processing: preparing for analytics

After the “open” combination of data, the data needs to be further processed. This as input for the advanced analytics. As better and smarter analytics are the basis for better output, from here the Muntstroom solution is proprietary.

3.6 Applications for analytics

Applications need to be developed to support advanced analytics. This to answer questions in the use cases like:

- What happened? (descriptive analytics)
- Why did it happen? (diagnostic analytics)
- What will happen? (predictive analytics)
- How can we make it happen? (prescriptive analytics)

In the data architecture the developed applications should be positioned close to the central storage environment.

As different users need different (levels of access to) information, the applications should not only respond to the use cases, but also consider the conditions for (re)using "private" data[3] and the difference between personal and non- personal data.

3.7 Smart Access

3.7.1 Supporting different business models

The Muntstroom PCP Group would like the desired solution to support different business models, like visualised in the figure below.

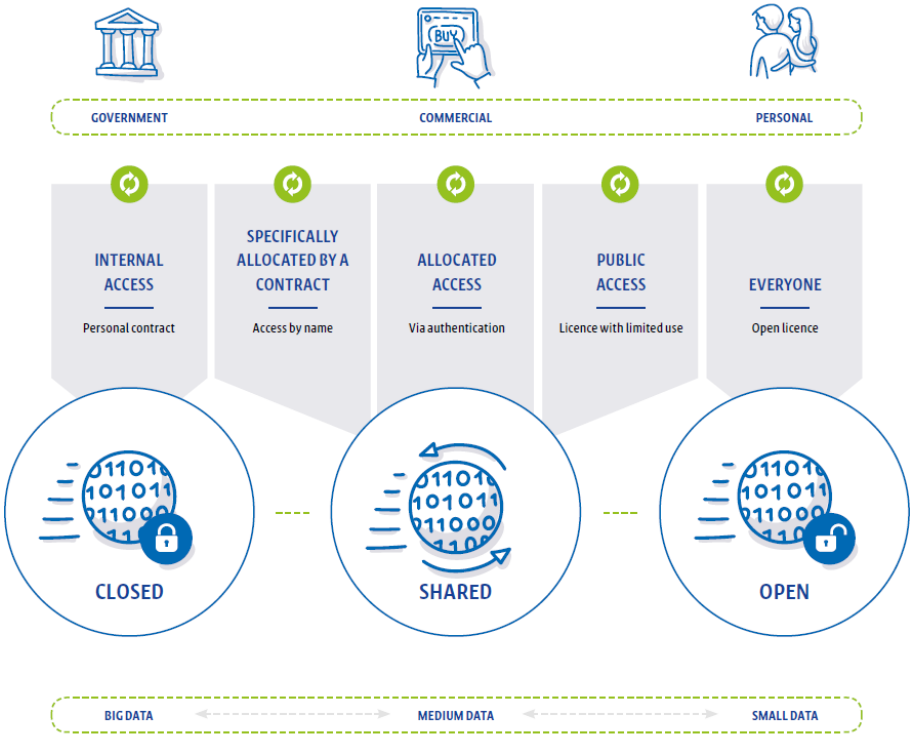


Figure 3: Different business models for data.
Source: Agoria White Paper Data (2018)

[3] For example a sensor that is owned by a private / non-public commercial organisation that is sending data to the platform.

In Annex 2 of the Market consultation document a use case on the Smart Access is elaborated. The underlying elements are elaborated in the table below. These elements and the use case will be supplemented with the outcome of the Open Client Dialogue.

Reason	Explanation
Closed	1. different Public users need to have access to different levels of information[4] 2. shielding of possible competitively sensitive information
Shared	3. output for users that do / dot not attribute with sensor data 4. output for users that do / dot not attribute with People Flow related data (Data broker) 5. different level of output can be combined into a product for specific users.
Open	6. to support EU and Brussels Open Data-requirements. Both existing and future. 7. to support research and economic growth

Table 2: Elements regarding the Smart Access

3.7.2 Data Broker-function

As part of the Smart Access a Data Broker-function should be developed

1. During PCP-phase 1 and 2 a billing environment (cash register) should be developed
2. During PCP-phase 3 the Data & Contract-validation should be tested.

3.8 End-user

Each controller will be responsible for the settings to pull data from the solution. The access should therefore be designed:

- In a way that allows the controller to enter default settings to request (or block) access to specific data sets.
- The introducing of these default settings must be ensured by additional steps and additional authorisation.
- To make it possible to link the default settings to different authorisation levels.
- To be able to cope with many different settings / security levels. Also within a company itself (different departments).

[4] E.g. public parties with and without security-related tasks. For one and the same use case, it should be possible to provide output both with and without personal data.

4 Privacy & security-by-design

The Muntstroom PCP Group would like an end-to-end solution that embeds privacy & security by design. See Figure 1: Data architecture of the desired solution.

4.1 Follow the river, but not the little droplets

As stated in chapter 2, the Muntstroom PCP Group would like to “follow the river, but not the little droplets”. This means that the desired Muntstroom solution should include an end-to-end solution for Privacy, Data Protection and security (privacy-by-design, security-by-design).

For instance (1): the desired output of chapter 3 is focussing on trends in people flow, not on the tracking of individual pedestrians.

For instance (2): PCP-suppliers are expected to support routing. To test this a routing app needs to be developed that can only be used after authorisation (opt-in) and is controlled by calculations that are being done on the smartphone itself (and NOT in de cloud.) The routing app only uses data from beacons, there is NO communication back to the platform.

Once such a routing-product or service is released to the public, the strictest privacy settings should apply by default, without any manual input from the end-user. Because of this, privacy-by-default is also a guiding principle.

4.2 Privacy-by-design strategies

The EU Agency for Cybersecurity (ENISA) has defined different strategies to integrate privacy and data protection principles directly in the design phase. When these strategies are mapped against the data architecture layer it shows clearly what Privacy Enhancing Technologies (PET) should be in place in the different stages. See Table 3. The Muntstroom PCP Group will ask technology vendors to present a similar figure with the data-by-design strategies they propose per data architecture layer.

4.3 User pulls information out of the system

The data/information should be pulled out of the system by a user and thus NOT be pushed by the system to the user. The general idea is that the user who pulls out the data/information from the system, should never get other information than the user is entitled to [for instance because of its public tasks]. Nor can a user receive more information than was requested. However, the solution itself contains all data captured to allow the ultimate re-use of this data.

Because of the above, security aspects like the identification, authentication and authorisation are also very important. See § 3.8 End-user.

	BIG DATA VALUE CHAIN	KEY PRIVACY BY DESIGN STRATEGY	IMPLEMENTATION
1	Data acquisition/collection	MINIMIZE	Define what data are needed before collection, select before collect (reduce data fields, define relevant controls, delete unwanted information, etc), Privacy Impact Assessments.
		AGGREGATE	Local anonymization (at source).
		HIDE	Privacy enhancing end-user tools, e.g. anti-tracking tools, encryption tools, identity masking tools, secure file sharing, etc.
		INFORM	Provide appropriate notice to individuals – Transparency mechanisms.
		CONTROL	Appropriate mechanisms for expressing consent. Opt-out mechanisms. Mechanisms for expressing privacy preferences, sticky policies, personal data stores.
2	Data analysis & data curation	AGGREGATE	Anonymization techniques (k-anonymity family, differential privacy).
		HIDE	Searchable encryption, privacy preserving computations.
3	Data storage	HIDE	Encryption of data at rest. Authentication and access control mechanisms. Other measures for secure data storage.
		SEPARATE	Distributed/ de-centralised storage and analytics facilities.
4	Data use	AGGREGATE	Anoymisation techniques. Data quality, data provenance.
5	All phases	ENFORCE/ DEMONSTRATE	Automated policy definition, enforcement, accountability and compliance tools.

Table 3: Privacy-by-design strategies / architecture layer
Source: Privacy by design in big data (ENISA, 2015)

5 General requirements

5.1 Eliminating future barriers

The design of the desired Muntstroom solution should eliminate any future barriers that stand in the way of data sharing. Here one should think about requirements like:

- Sensors
  - Simple installation of sensors, flexible use and low energy use (to support temporary use. E.g. around events and roadwork)
  - Being able to function in different urban configurations (street, square, shop interior, metro station, etc.).
- Avoid vendor lock-in (architecture independent of technology and open data-formats)
- Mobile-by-design / responsive web design + analytics
- The usage of cloud-agnostic technologies.
- (near-to) Real-Time response times

5.2 Languages

- the technical interface of the final solution should be made available in English.
- the user interface of the final solution should be made available in at least French and Dutch.

5.3 Ownership of the data

The current idea of the ownership of the data is as follows

	Only sensor data	Combined with external data
Sensor data	Of sensor owner	Idem
Combined sensor data	Jointly, by sensor owners	Idem
Added external data	-	Depends on license conditions of data provider
Enriched by analytics	Jointly, by sensor owners	In principle jointly, by sensor owners. But depends on license conditions of data providers

Table 4: Ownership of the data in 2 different scenarios

5.4 Accessibility of the output

The output should be accessible via a computer, tablets and smartphone. The desired Muntstroom solution should thus be mobile-by-design and have a responsive web design and analytics.

5.5 Intellectual Property Rights and royalty scheme

The desired Muntstroom solution consists of two chunks (see Figure 2):

1. Collecting the data via open standards and combining the data and basic processing via open source software
2. Advanced processing, analytics and smart access via a proprietary solution

The ownership of the be developed solution will belong to the PCP-participant(s) that have/has developed the solution. The Muntstroom PCP Group will request free licenses for use.

5.6 Interoperability during and after the PCP

During PCP-phase 3 (the Living Lab-phase) the Muntstroom solution will be tested in a greenfield. Therefore, no integration with the IT systems or datasets of the members of the Muntstroom PCP Group will be required.

However, the Muntstroom PCP Group does want to have a better understanding of the requirements on interoperability for the subsequent PPI. Hence, during the PCP, the Muntstroom PCP Group intends to require the PCP-suppliers to elaborate on how they would integrate their solution into the existing systems as well as to define/estimate the Total Cost of Ownership (TCO) of such integration.

5.7 Minimal Total Costs of Ownership

The Muntstroom PCP Group would like to control / minimize the Total Costs of Ownership (TCO). As a prerequisite this means that:

- The sensors need to
  - be as stable as possible
  - be easy to install, be maintained and/or be replaced
  - have a minimal susceptibility to interference
  - have a long lifespan
- against a CAPEX and OPEX that is as low as possible.
- The intelligence and innovation need to be, in particular, in the platform and not in the sensors.

5.8 Energy use

As part of the TCO, energy usage / costs are an important requirement. This will depend on different aspects, like:

a) The number of sensors and the sort of sensor technology that are used.
b) The connectivity needed to transport data over a certain distance
c) The availability of an access to the electric grid (battery use or solar panels instead)

5.9 Data quality

The output data should have a certain data quality. The European Data Portal has indicated three indicators to assess the quality of any dataset[5]:

- Content quality - datasets should be complete and accurate.
- Timeliness - data must be up to date and must be published as soon as an update is available.
- Consistency - standards must be used, and published data must be consistent in terms of equal quality and continuity over time.

To evaluate this, the Muntstroom PCP group will request data quality management plans from the technology vendors and their compliance thereof:

- During PCP-phase 1 quality management plans as part of the deliverables (incl. definition of data quality, security, privacy)
- During PCP-phases 2 and 3 the technology vendors will be evaluated based on the compliance with their quality management plans.

[5] source: Business-to-government data sharing for the public interest (European Commission, 2020)

6 Testing in a living Lab

The prototypes of PCP-phase 2 will be tested in a real environment during PCP-phase 3.

6.1 The foreseen test area

The foreseen test area is on, around and under the Brussels Place de la Monnaie / Muntplein.

The Muntplein is amongst other a microcosmos for mobility. There are for instance 2 carparking garages (above and underground), an underground secured bicycle parking, an underground combined metro- and tram (prémetro)station, various bus stops and a lot free floating bike and-scooters.

Most importantly, there are many pedestrians who cross the Place de la Monnaie every month between the shopping districts of Rue Neuve and the Rue des Fripiers.

The Place de la Monnaie accommodates known destinations like shopping mall De Mint, the Muntpunt library, Opera House La Monnaie / De Munt, hotels and horeca.

Last, during the year many events are being organised on the square.

6.2 Testing use cases

The testing during the Living Lab-phase will be done by means of use cases. See Annex 2 of this Market consultation document. The PCP-suppliers will be required to address mandatory and “nice to have” use-cases. This way PCP-suppliers will be challenged to go beyond the minimum required.

List of Acronyms

Abbreviation	Word
BCR	Brussels Capital Region
CIRB – CIBG	The Brussels Regional Informatics Centre
CMS	Content Management System
Eafip initiative	European Assistance for Innovation Procurement initiative
EU	European Union
FAIR	FAIR-principles: Findable, Accessible, Interoperable, Re-usable[6]
FRAND	Fair, Reasonable and Non-Discriminatory
IPR	Intellectual Property Rights
MaaS	Mobility as a Service
OECD	The Organisation for Economic Co-operation and Development
OCD	Open Client Dialogue
OMC	Open Market Consultation
OSS	Open Source Software
PA	Process Automation
PCP	Pre-Commercial Procurement
PETs	Privacy Enhancing Technologies
PPI	Public Procurement of Innovative solutions
PRM	Persons with reduced mobility
R&D	Research and Development
SOTA	State of the Art Analysis
STIB-MIVB	Brussels Intercommunal Transport Company
TCO	Total Cost of Ownership
TED	Tenders Electronic Daily
TRL	Technology Readiness Levels

[6] Directive (Eu) 2019/1024 of the European Parliament and of the Council of 20 June 2019 on open data and the re-use of public sector information. Official Journal of the European Union L 172/56, 26.6.2019. Recital 27. Article 10. Research data. *"1.Member States shall support the availability of research data by adopting national policies and relevant actions aiming at making publicly funded research data openly available ('open access policies'), following the principle of 'open by default' and compatible with the FAIR principles. In that context, concerns relating to intellectual property rights, personal data protection and confidentiality, security and legitimate commercial interests, shall be taken into account in accordance with the principle of 'as open as possible, as closed as necessary'. Those open access policies shall be addressed to research performing organisations and research funding organisations."*

Annex A: People Flow-data

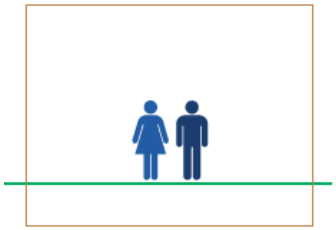
To support policy development on pedestrians and PRM and taking effective measures, the Muntstroom PCP Group wants the collected data to be structured in accordance with the Public Life Data Protocol (2017)[7] of the Gehl Institute.

The Public Life Data Protocol describes a set of metrics that are important to the understanding of public life—people moving and staying in public space—and aims to establish a common format for the collection and storage of such data. See e.g. the figure and table below.

[7] https://gehlpeople.com/tools/public-life-data-protocol-beta/

GENDER

Applies to people staying and moving



Example Questions:

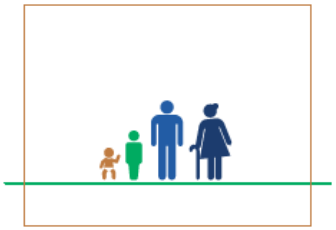
Do all genders feel equally invited?

Are the planned activities in accordance with the users of the place?

Do gender minorities choose to walk in public at night?

AGE

Applies to people staying and moving



Example Questions:

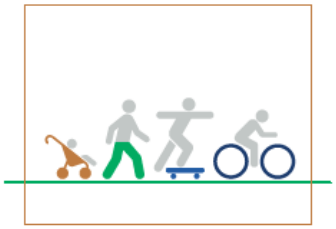
How many children visit this place?

Do the people on the street match the census data for the area?

Do the elderly have adequate facilities to spend time outside?

MODE

Applies to people moving



Example Questions:

What is the detailed mode-split across a street section?

Is the street of the right width and surface type for the users?

How many people move through the space at night?

GROUPS

Applies to people staying and moving

Example Questions:

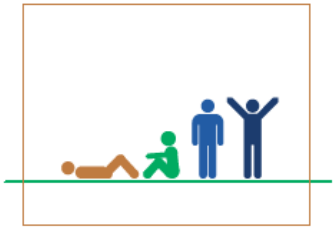
How sociable are the people staying within this place?

Does the urban furniture provide opportunities for groups to meet?

Do people need space to walk in pairs?

POSTURE

Applies to people staying



Example Questions:

Do people feel comfortable lying down and sitting within the space?

Are there invitations for people to rest?

How do people use the urban furniture and other elements within the space?

ACTIVITIES

Applies to people staying and moving

Example Questions:

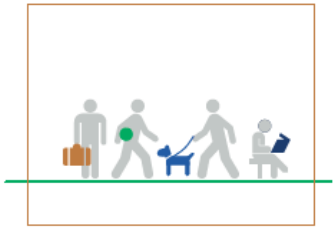
Are people engaged in a single activity or multiple activities?

Are the activities that people spend time doing optional or necessary?

What is the diversity of activities?

OBJECTS

Applies to people staying and moving



Example Questions:

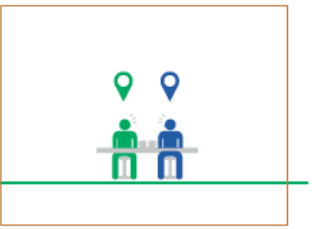
How many of the pedestrians are also walking a dog?

Do people carry their own chairs or blankets into the space?

Are bicyclists wearing helmets?

GEOTAG

Applies to people staying



Example Questions:

Which corners of the space are more popular for people to spend time in?

Are some kinds of urban furniture more popular than others?

What is the impact of shade and sun?

Figure 4 : Public Life survey components
Source : Public Life Data Protocol (Gehl Institute, 2017)

Category	Sub-category	Advanced	Content	Description
Pedestrian	Walking		Strolling	Pedestrian walking leisurely with intermittent stops.
			Average pace	Pedestrian walking at an average human walking pace.
			Brisk	Pedestrian walking briskly and determined without looking anywhere but ahead.
			Other	Any other type of walking that does not fall in any other category.
	Running		Jogging	Pedestrian running at an average or leisurely pace.
			Sprinting	Pedestrian running determined and at a pace that is too fast to notice the surroundings.
			Skipping	Pedestrian running with a skipping step.
			Other	Any other type of running that does not fall in any other category
	Supported	Lightly	Rollator, Walking cane, Guide cane, Long cane, Cart, Crutches, Guide dog, Other	Pedestrian walking with light support, typically from an object or an animal, to overcome any type of perceived mobility impairment or disability.
		Heavily	Wheelchair: manual, electric, pushed or other	Pedestrian moving with heavy support, typically from a wheelchair, to overcome any type of perceived mobility impairment or disability.
	Carried	Wheels	Stroller, Pram, Cart, Other	Pedestrian being moved by other people in objects on wheels who is not perceived to be subject to any mobility impairments or disability. Typically children in strollers or prams.
		Body	Arms, Sling, Carrier, Back, Other	Pedestrian being carried on the body of another person who is not perceived to be subject to any mobility impairment or disability. Typically children being held by their parents.
	Rolling	Manual	Scooter, Skateboard, Rollerblades, Heelies, Longboard	Pedestrian moving by an optional, light, manual vehicle with wheels.
		Powered	Moped, Skateboard, Uniwheel, Segway	Pedestrian moving by an optional, light, powered vehicle with wheels.

Table 5: Categories and subcategories for the mode pedestrians
Source: Public Life Data Protocol (Gehl Institute, 2017)