
Requirements Specification

For Urban Platforms

Version 2.2
(Consultation Stage)

Prepared by Demand-Side Engagement Stream



European Innovation Partnership for Smart Cities & Communities (EIP_SCC)
Integrated Infrastructure Action Cluster – Urban Platform

Requirements Specification Life-Cycle

Revision history

Author	Date	Reason for change	Phase	Revision
Dr. Larissa Romualdo-Suzuki	4/12/2015	-	Initial Draft Outline	Version 0
Dr. Larissa Romualdo-Suzuki	21/12/2015	Working update	Core Demand-Side Team Consultation	Version 1
Dr. Larissa Romualdo-Suzuki	05/01/2016	Incorporate cities comments	Development	Version 2.1
Dr. Larissa Romualdo-Suzuki	29/01/2016	Incorporate suggestions from Urban Platforms Workshop held in Brussels on the 19/01/16.	Development	Version 2.2

Requirements Specification sign-off:

Name: Andrew Collinge Role: Demand Side Engagement Lead Organisation: Greater London Authority	Date 11 January 2016
---	-------------------------

Acknowledgement:

This document has been developed in consultation with a representative group of European cities from different locations, size, and level of development. Cities include: London, Amsterdam, Barcelona, Syracuse, Berlin, Gent, Valencia, Murcia, Derry, Copenhagen, Scottish cities, Porto, Riga. We wish to recognize the commitment, support and ongoing contribution from these cities to develop a common statement of needs.

Table of Contents

Table of Contents	iii
1. Introduction	1
1.1 Purpose and Scope of this Document	1
1.2 Context	1
1.3 Intended Audience	2
1.4 Definitions, Standards, and Framework	3
1.5 How to Use this Document	2
1.6 Product Scope and Perspective	5
1.7 The Urban Platform Development Stack	7
1.8 User Classes, Characteristics, and User Access	8
1.9 User Documentation	10
1.10 Design and Implementation Constraints	10
1.11 Assumptions, Alignment with other Action Clusters and Policies	10
2. Urban Platform Value Proposition, Use Cases and Functional Requirements	12
2.1 From Value Proposition to Platform Specifications	12
2.2 Overall Goal: "City data is exploited to its full potential"	13
2.3 SUB-GOAL 1: City data is collected in an intelligent manner	15
2.4 SUB-GOAL 2: City data is managed in a safe and intelligent manner	20
2.5 SUB-GOAL 3: City data is orchestrated in a marketplace	23
2.6 SUB-GOAL 4: City data is offered in an accessible manner	28
2.7 SUB-GOAL 5: User's experience is enhanced by the provision of value-added services	31
3. Non-functional Requirements	34
3.1 Run-time Quality Requirements	34
3.2 Non Run-time Quality Requirements	37
3.3 List of Non-Functional Requirements	38
4. Other Requirements	39
4.1 Minimal Descriptive Metadata Required from Data Provider	39
4.2 Urban Platform Supported Data Formats	40
5. Conclusion & Forward Plans	40
Appendix	Error! Bookmark not defined.

1. Introduction

1.1 Purpose and Scope of this Document

The purpose of this document is to provide a common core set of city-needs-led requirements, co-developed and validated by EU cities, to support the acquisition of “Urban Platforms” by EU cities. The requirements are made openly available. The ambition is that adoption of these requirements by EU cities will lead to reduced pre-procurement times, increased confidence in platform designs, greater levels of collaboration (particularly amongst smaller cities), innovation in business models, more affordable solutions, and a more secure basis for industry to apply its innovations. This will lead to accelerated adoption of urban platforms by EU cities, so that they can exploit the potential of the growing volumes of city data, and improve the services to and outcomes for their residents, business community and visitors.

This document provides a primary input to the EIP_SCC Urban Platform Supply-Side and Standardisation workstreams as a reference for the development of further technical and operational materials. The requirements illustrate the purpose and complete declaration for the development of system, as well as system constraints, interface and interactions with other external applications.

The scope of this document is limited to common services data platform requirements, and issues related to the management of city data within an Urban Platform. This considers the full life-cycle of city data, including: the maintenance of the inventory of existing city data; development of functional requirements for common services data platform from a city-needs perspective; identification of metadata and format standards for city data; and identification of policy issues related to the data platform. It includes in the scope the functionality of software and systems used to handle existing data catalogues (e.g., open data portals).

Commercial off-the-shelf (COTS) software or hardware, as well as databases, which manage data that are not part of Urban Platform’s collecting responsibility (e.g., mobile applications, proprietary Internet of Things, proprietary data catalogues) are outside the scope of these requirements.

1.2 Context

The initial EIP_SCC Demand-Side survey¹ clearly indicated that the vast majority of EU cities did not have an urban platform; that there were a number of significant barriers to adoption (including funding, capabilities, and the willingness to work across service ‘silos’); that there was limited collaboration in this area; and as a result most cities were ‘sitting on the fence’. The opportunity clearly is to unblock this. Notably because urban platforms provide a vital foundation for smart city infrastructure and service improvements. So their adoption is considered a strategic priority by the EIP_SCC, and by a growing number of cities.

There are a number of clear trends that any city, and thus these requirements, must recognise:

- The astounding increase in volumes of city data, driven notably by IoT/sensor/M2M implementations, and social media
- The pressure to improve and make open data from public (and private) sources;

¹ Survey performed Q1’15 and reported on the EIP_SCC Marketplace site

- The continued reality of austerity that drives cities towards transformative solutions

Cities presently typically have a mix and variety of qualities of legacy systems, with various degrees of technical 'platform or platforms' in place. It is recognised that the roadmap a city might follow to transition to a more aligned and functional state will differ in many ways; and that the end point does not envisage 'one (physical) platform'. However cities will benefit from adopting more consistent conceptual, and logical architectures, which will lead to more efficient and effective physical operations, and greater benefits in terms of exploiting city data.

Furthermore it must be recognised that cities will continue to wrestle with capacity challenges to improve quality, availability, governance, and appropriate monetisation of city data.

1.3 Intended Audience

This document is co-developed by and initially intended for the growing number of city members of the Demand-Side Engagement Stream of the EIP_SCC Urban Platform initiative. Its formal release as a common statement of requirements by representative EU cities will form the basis for commitment by EU cities to the initiative by way of a Letter of Intent (LoI). The spirit of which seeks to ensure broad use of these requirements by EU cities (and recognition of deviations) to help open the smart city market.

It is also intended to be used by Industry in setting an agreed city-needs-led set of requirements which can become more consistent and common across EU cities. This will lead to advantage for cities and Industry.

1.4 How to Use this Document

Cities are encouraged to use this document as a guiding reference for the development of their own platform specifications.

The following steps offer a logical means to extract the full value of this document:

1. Identify the priority service outcomes that the city seeks to achieve to steer the overall prioritisation of urban platform development
2. Perform a city data mapping exercise to develop a picture of the data landscape, including: sources, volume, variety, temporal factors and sensitivity, data licensing and ownership policies.
3. Map out existing ICT system resources across the city in order to identify those resources with the greatest potential for reuse, identify gaps and provide the foundation for a data strategy and technology plan to fill them.
4. Identify the requirements within this document that best suit the city needs - alongside any other emerging requirements – and refine and prioritise them in accordance to their data strategy defined in step 1 and 2.

5. Cities can create their own specification document in their own language and refer to the requirements of this document by using the unique identifier of the requirements (which signals to providers the similarities and deviations from the core set)
6. Determine what ICT infrastructure and sets of requirements are needed citywide to support the urban platform.

1.5 Definitions, Standards, and Framework

To ensure a robust basis for market adoption we have set in place a number of foundations. Firstly, a common definition of terms. Secondly, the adoption of some core accepted standards. Thirdly, an underlying model to develop requirements.

1.5.1 Working Definitions

For the purpose of this document we assume the working definitions developed within and shared across all working groups of the Urban Platform initiative

- **An 'Urban Platform'...**

- Implements a logical architecture/content/design that brings together (integrates) data flows within and across city systems and exploits modern technologies (sensors, cloud services, mobile devices, analytics, social media etc);
- Provides the building blocks that enable cities to rapidly shift from fragmented operations to include predictive effective operations, and novel ways of engaging and serving city stakeholders;
- Transforms, in a way that is tangible and measurable, outcomes at local level (e.g. increase energy efficiency, reduce traffic congestion and emissions, create (digital) innovation ecosystems, efficient city operations for administrations and services).

- **'City Data' is...**

- Data that is held by any organisation - government, public sector, private sector or not-for-profit - which is providing a service or utility, or is occupying part of the city in a way that can be said to have a bearing on local populations and the functioning of that place;
- Consists of varied characteristics such as static, near-real time or in the future, real time, descriptive or operational.
- It will be to a greater extent generated by individual citizens and this too (with due consideration to privacy and a strong trust framework) can be considered city data.

For the purpose of this report, the following terms and definitions⁴ apply.

- **Open data:** non-privacy-restricted and non-confidential data. Produced with either public or private resource and is made available without any restrictions on its usage or distribution.
- **Private data:** restricted and/or licensed data including permission, charging, privacy, publication and distribution. Produced with either public or private resource.
- **Commercial data:** restricted and/or licensed data including permission, charging, privacy, publication and distribution. Produced with either public or private resource.

- **Sensory data:** open and/or restricted data collected by different sensors, actuators and devices owned by public and private sector, and citizens. Sensory data is usually diverse in nature and architectural features, mostly location and time dependent, and present different levels of quality.

These types of city data are produced within the public and private sectors and crowdsourcing initiatives, and have their respective suppliers and distribution strategies (e.g. reports, APIs, datasets).

- **Public sector data:** restricted data relating to location, national security, commercial sensitivity and privacy. Data produced, collected or funded by the public sector.
- **Private sector data:** data produced, collected or funded by the private sector, which can be open, private and commercial data. In case of private data, the restrictions of usage and distribution are decided by the individual businesses.
- **Crowd-sourced data:** data provided, collected and distributed by humans through the use of digital technologies and social media.

1.5.2 Use of Standards

- We seek to ensure Urban Platforms in EU cities are designed with regard to international best practices for data repositories.
- As new guidance and standards are developed the three streams of the EIP_SCC² Urban Platform initiative will review them for broader use. (Note: the SCC03 EC project and consortium is explicitly linked within this initiative and will act on Urban Platform standards).
- For now, this document assumes a modified IEEE 830-1998³ layout for software requirements specification, as the basis to capture a high-level statement of the urban platform's requirements.

1.5.3 The Organising Framework

This document uses the dynamic business models framework⁴ illustrated in Figure 1 to organise and guide the definition of goals, the development of use cases, and definition of requirements during the life cycle of urban platforms. Future iterations of this dynamic design process are Procurement, Roll-Out and Market phases. Consequently, this document may include, alter, prioritize, extend or remove specifications as they become known.

The principal goal addressed is that of “**exploiting the value of city data through urban platforms**”. From this we have developed five common sub-goals. Each includes: a description; rationale; drivers; and actions. These sub-goals are elaborated through a total of 14 use cases and developed into a total of 116 functional and non-functional requirements as illustrated in Figure 2. The use of the requirements by Industry will be subject to a further update.

² EIP Integrated infrastructure Urban Platform Governance Model, Version 3, 28th July 2015.

³ IEEE 830-1998 Standard for Software Requirements Specifications, 1998.

⁴ Framework for Data Infrastructures Design from “Data as Infrastructure for Smart Cities”, Suzuki-LCSR, PhD Thesis, UCL, 2015.

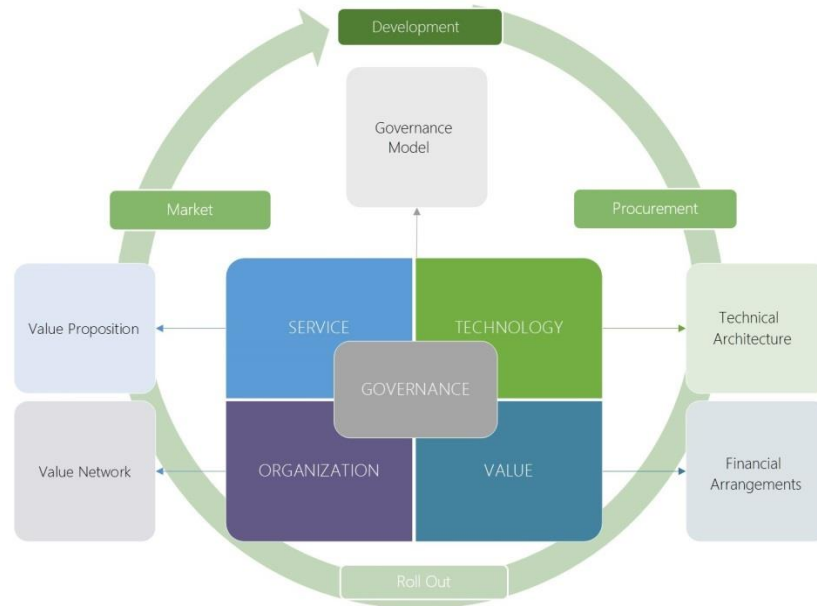
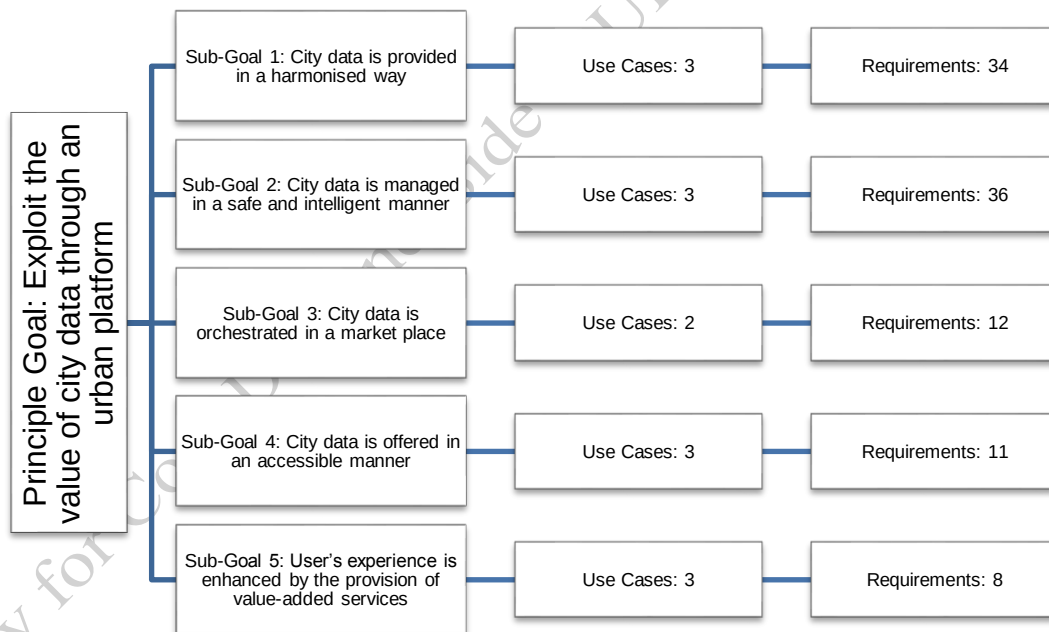
Figure 1. Organising Framework⁴.

Figure 2 Structure of this document.

1.6 Product Scope and Perspective

The EIP Project's urban platform is an open common architecture which serves for city data collection, management and distribution. An urban platform is intended to support the widespread exploitation of city data by humans and machines in the urban environment. Figure 3 illustrates a holistic high level overview of the urban platform the EIP project intends to deliver.

The reference architecture for urban platforms should:

- Cater for interoperability between urban infrastructures
- Enable replicability of the solutions/platforms city to city
- Scale without technical constraints and excessive cost increase
- Provide open APIs and SDKs
- Enable Real Time capabilities
- Support implementation of functional and technical capabilities

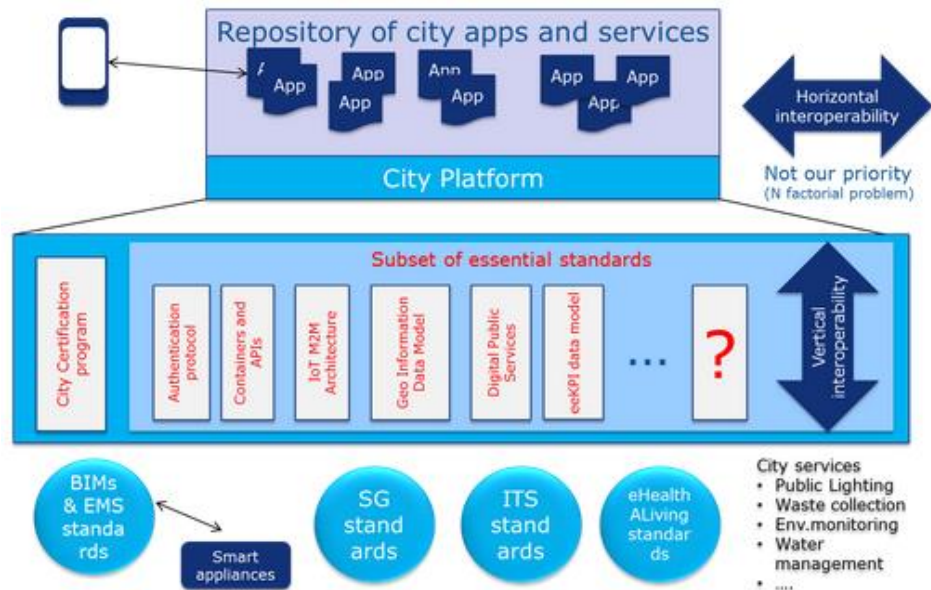


Figure 3. High level overview of the urban platform (currently approved EC DG CNECT).

The current urban platform market is nascent. Many software vendors offer such a platform, though many requirements and expectations of the stakeholders of city data are not (fully) addressed. As a result, current urban platforms are often more costly to design and maintain, less reusable and often not interoperable platform-to-platform, and susceptible to information fragmentation and overload.

The urban platform which the EIP initiative intends to design takes a step beyond the platforms currently on the market by ensuring the requirements are fully founded on a co-created and common set of representative city needs, from which it solicits suitable industry input, and an open and managed collaboration between industry, cities and communities, and others, in order to take into account their needs and concerns. To do this, it is necessary to take a technology agnostic approach to design an open and common reference architecture for urban platforms. This platform must ensure data is collected and sustained in accordance with well-established standards, managed in a robust manner so that it can handle high level supply and demand of data, and distributed across different value chains, systems and stakeholders. The ability to handle high level of city data supply and demand while being user secure and accessible enough for city-wide exploitation of data is one of many keys to the success of urban platforms. This is central to the design and implementation of urban platforms.

1.7 The Urban Platform Development Stack

The requirements specification of this document is based on the Urban Platform Development Stack illustrated in Figure 4. The stack is composed by five domains (represented as layers in the stack) necessary to fully implement an urban platform software suite as shown in Table 1. Each domain comprehends a set of requirements necessary to the design of a common and open urban data service platform. The elicited requirements are used to define a technical architecture which is simple enough to be comprehensible at least at a high level of abstraction. The platform should be conceptually decomposable into its major subsystems, the platform's functionality reused by many services and external applications should be identifiable, and interactions between the platform and services, data providers and data consumers should be well defined and explicit.

The first layer of the stack "Societal needs" concerns to outcomes we strive for within a portfolio of city service domains. An urban platform should recognise societal needs and wants as the starting point for city data service offering. Ultimately, an urban platform aims to provide tailor made and compelling engaging services for the users. The Services and Business models layers concerns with delivering data services which carefully targets the needs and expectations of the different users of the urban platform, and explore use cases and commercial models where data is used to deliver different forms of value. The city data layer concerns with the mechanisms necessary to transform urban platforms into a foundation for widespread exploitation of data, including handling data architectural features, data usability, semantics and quality aspects. The urban platform layer concerns to the technology foundation to configure, share, and interpret exponentially increasing volumes city data and services. Finally, the Infrastructure layer concerns with the base level connectivity that supports the platform to be scalable and reliable in the long run.

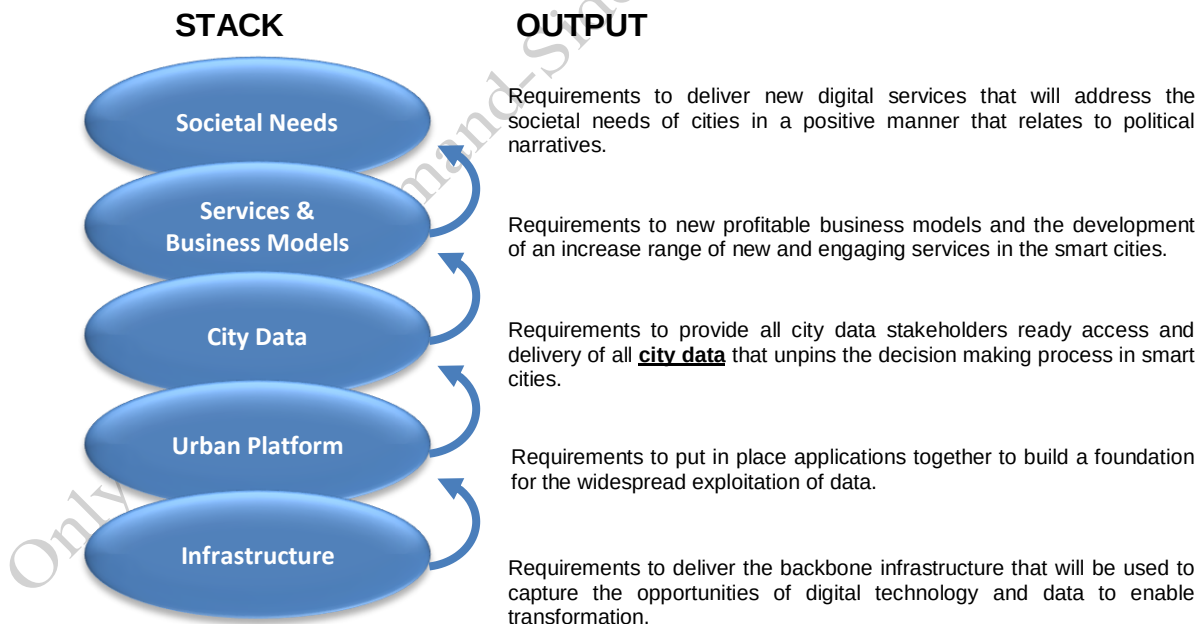


Figure 4. Urban Platform Development Stack.

Table 1. Urban Platform Development Stack

Layer	Rationale
Societal Needs	- Accessible services and data necessary to solve social problems and drive innovation; - Parameters that influence user's experience while interacting with services (e.g. usability, feeling of security and trust);
Services and Business Models	- Tailor-made data services which carefully targets the needs of users and businesses; - New potential and cost-effective beneficial services that could be rolled out across cities of different sizes; - Use cases where data is used to deliver different forms of value.
City Data	- Data architectural features (e.g. volume, variety, temporal factors and sensitivity); - Data licensing, policies and regulations to exploit data to full effect; - Minimum metadata requirements; - Data usability and reusability aspects of humans and machines.
Urban Platform	- Holistic and interoperable solutions; - Integrated approaches which ensure that services fit together and that synergies can be exploited; - Data management mechanisms to ensure data integrity and compliance with data protection regulations - Extension capabilities to accommodate additional functionality at later stage at a fair and transparent cost.

1.8 User Classes, Characteristics, and User Access

The users of the Urban Platform include **end-users**, such as the general Public, public and private organisations; **data providers**; **service providers**; and the **platform providers** who will be working with the providers of city data and services, and managing the content, defining policies and regulations of the platform. A crucial feature of an urban platform is the provision of the various access levels required by the different types of users. Particular users need different access levels to some data than the general public. Data publishers will require access to the Urban Platform in order to ingest, administer, manage, preserve and access their resources. This will require multiple levels of access to city data and its respective metadata. Table 2 provides a description of each class of users.

Table 2. Actors

User Class	Rationale
Platform Provider	- Maintains the ecosystem of data, services and users; - Defines standards, licenses and regulations and provides terms and conditions for platform usage and the commercial exploitation of data and services; - Decides who are allowed to join the value network of data and services providers;
City Data Publisher	- Publishes open and proprietary data into the platform; - Manages and maintains resources in the platform accordingly to terms and conditions.
Data Services Provider	- Deploys open and commercial data services into the platform (e.g. data visualisation, data cleansing, data integration tools); - Manages and maintains resources in the platform accordingly to terms and conditions.

City Data Consumer	- Consumes open and proprietary data provided in the platform; - Uses open and commercial data services provided in the platform; - Provides feedback on data and services provision;
--------------------	---

1.8.1 End-User Access

City data consumers will need to access and use the city data residing in the Urban Platform. End-users will be able to search metadata and full text within datasets (when available), and obtain city data in open formats readily available to both humans and machines such as CSV, XML, JSON. Some end-users may require different access rights to city data. The 2 major end-user groups that have been identified are:

- Open data users, including both national and international users (humans and machines). Open access to some city data may be restricted by licensing terms (e.g. commercial data), embargo periods, copyright, etc.
- Private data users, which need to use the Urban Platform to obtain commercial city data. Data access is available via data subscriptions or when purchase requirements and licenses are waived by the data provider.

1.8.2 City Data Publisher Access

A broad data provider level access is needed for stakeholders (humans and machines) working with the urban platform and their respective data in it. Basically, data publishers will carry out the following activities:

- Data publication access, available to publishers adding new data and metadata, checking the quality of datasets, manipulating data, performing format conversions, defining data-access level, tariff for consumption when applicable, and licences.
- Data maintenance access, for publishers reviewing or editing appropriate data and metadata in the urban platform. Data publishers can view data and add to or edit metadata without changing the data itself. They should be provided with access to feedback from users to investigate problem in their resources (e.g. missing data, inconsistent metadata), and statistical information about how their resources are used by users.

1.8.3 Data Services Provider Access

This is the second most restrictive access level providing rights to deploy services in the platform. Basically, data service providers will carry out the following activities:

- Data services deployment access, available to service providers adding new mechanisms or integrating new applications, testing and validating integration, defining data-access level and tariff for service usage.
- Data services maintenance access, for services providers reviewing, extending or editing applications in the urban platform. Data services providers can view their services deployed and add to or edit access level and tariff without having to deploy the services again. They should be provided with access to feedback from users to investigate problem in their services (e.g. bugs, scalability issues), and statistical information about how their services are used by users.

1.8.4 Platform Provider Access

This is the most restrictive access level providing ultimate rights to the system and is required for its management, development, and assigning appropriate rights to data and services providers. Policies and regulations, license agreements are also defined by the provider of the urban platform. Platform providers should be provided with the means to follow up on civic engagement (e.g. feedback, request for city data) and on the provision of city data and services.

1.9 User Documentation

- **City Data Consumers:** Provide license terms and conditions associated to consuming data and services provided in the platform, documentation of APIs and guide to discover city data in the platform.
- **City Data Providers:** Provide data publication documentation describing the minimum metadata requirements, formats accepted, step-by-step guide to publish accurate city data.
- **Data Service Providers:** Disclosure technical and architecture blueprint details in order share and outsource expertise, and partnerships, and integrate supporting partners' solutions into the platform itself.

1.10 Design and Implementation Constraints

1.10.1 Design Constraints

- Lack of standards agreement for metadata representation.
- City data found in existing data catalogues may require special consideration concerning the type of formats and datasets that must be stored within the platform.
- Requirements mismatch due to increased number of stakeholders involved in the design

1.10.2 Implementation Constraints

- Evaluation and testing of software options is expected to occur prior to selection and implementation of a production urban platform.
- Budget costs are unknown until evaluation of software options is completed.

1.11 Assumptions, Alignment with other Action Clusters and Policies

1.11.1 Assumptions

The assumptions in Table 3 have been identified by the Demand Side Engagement Stream as relevant to this Requirements Specification.

Table 3. Assumptions

#	ASSUMPTION
1	The providers of city data and services will be responsible to maintain their resources in the platform.
2	All city data must meet the minimum metadata requirements and use the standards adopted by the platform.
3	The platform shall consider open Source as an optional commercial model, with open standards as a principle
4	The system design and architecture should minimize fragmentation of city data in the urban platform.
5	To the extent possible, automation should be used for the extraction of descriptive and technical metadata.
6	The platform must be designed in a way it accommodates additional functionality at later stage at a fair and transparent cost.
7	The platform must be a modular based architecture which relies on stable and well-defined open interfaces to ensure interoperability between the platform, services and the applications provided by service providers.
8	The platform will offer open and well-documented API's and clear service descriptions and contracts that is offered for reuse by another party to foster open innovation in the city, which means that developers and interested individuals openly utilize the resources provided.
9	Adopt open and published European and International standards where possible.
10	The platform must be flexible enough to accommodate different local, National and International data protection, licensing and commercialization regulations.
11	Platform providers will monitor emerging technologies in order to maintain and improve the architecture.
12	Platform providers will monitor emerging information standards, including metadata standards and data interface standards.
13	Platform providers will monitor new commercial models for city data exploitation

1.11.2 Alignment with Citizen's Focus Action Cluster

This specification document is aligned with the principles defined in the Citizen Focus⁵ Action Cluster of the European Innovation Partnership on Smart Cities and Communities. Citizen Focus' is about "working together with citizens to realize public interests at the intersection of **ICT, mobility and energy in an urban environment**". We recognize citizens as owners of and participants in the creation and delivery of city data and digital services, and we specify requirements to deliver new digital services that will address the societal needs of cities in a positive manner that relates to political narratives. Societal needs and wants are considered the starting point for city data service offering by the urban platform. The requirements in this document were elicited considering

- Human behaviour and needs as important as technology;
- The services and data that solve social problems and drive innovation;
- The mechanisms that make data and services more accessible to users;
- The factors that influences user's experience while interacting with services provided (e.g. usability, feeling of security and trust);

⁵ <https://eu-smartcities.eu/node/1333>

1.11.3 Policies to be developed

The following policies have been identified by the Demand Side Engagement Stream as relevant to this Requirements Specification.

- **Data formatting and Metadata Schemes:** Urban platforms will require more expansive, robust and useful data encoding and conversion than what is available in existing data catalogues. Data preservation policies should be developed to allow data to be stored in formats that can be migrated, associated with metadata and ontologies to become both human and machine readable and understandable, ongoing monitoring for data obsolescence, and migrating data to systems environments as needed to ensure their continued availability. Current Metadata schemes (e.g. open data, sensory data ontologies) should be reviewed to see if it meets current needs for city data management. It is possible that the needs of the urban platform designed here may require new or additional schemas.
- **Data commercialisation:** The commercial exploitation of city data and their funding models are unexplored concepts that we are committed to address. There is an urgent need to define license agreements and fair commercial and subscription models to allow interoperable open and proprietary data to co-exist in the platform.
- **Data publication and services deployment:** Policy development will be needed regarding ingesting data and deploying data services into the platform, including which users/machines will be authorized to submit data for publication, the minimum requirements for data submitted by open and proprietary data publishers, and the removal of resources and services from the platform.

2. Urban Platform Value Proposition, Use Cases and Functional Requirements

2.1 From Value Proposition to Platform Specifications

This document uses goal-oriented modelling for eliciting, elaborating, structuring, specifying, documenting, and modifying requirements. Goals represent the objectives which the urban platform should achieve through cooperation of actors in the intended system and in the environment. They capture, at different levels of abstraction, the various objectives the urban platform under design should achieve. Through goals modelling we consider how the value proposition and intended solutions connects across the stack, how the urban platform meets city goals, why the system and its functionality are needed, and how the stakeholders' interests may be addressed.

In our specification, we present the overall goal (the **value proposition**) that the urban platform should aim to **achieve** in order to be considered as a viable final product, and a set of sub-goals (**intended solutions**) it should **maintain** in the long run so that the overall goal can be unceasingly achieved. By using this approach, the low-level technical requirements can be traced back to high-level strategic objectives of the urban platform. The formal notations used in this document are: Achieve [*Name of Overall Goal*] and Maintain [*Name of Sub-Goal*]. The requirements of the Urban Platform are noted for each of the sub-goals, and are presented as a series of statements regarding the capabilities needed in to achieve the overall goal of the Urban Platform.

2.2 Overall Goal: “City data is exploited to its full potential”

An urban platform is an organization of people and systems, which has accepted the responsibility to preserve city data and make it available for all the stakeholders of smart cities. Ultimately, an urban platform is a foundation for the full exploitation of city data. Hence, the major goal an Urban Platform must **achieve** is “city data is exploited to its full potential”. To achieve this high level goal, the urban platform must **maintain** in the long run the five sub-goals illustrated in Figure 3.

Each one of the defined sub-goals co-enables the achievement of the specified high-level (overall) goal of the urban platform. The sub-goals include the ingestion of city data, metadata generation, data management, data storage, access, preservation, and administration, provision of engaging services in the smart cities. These sub-goals are discussed in details in the following sections.

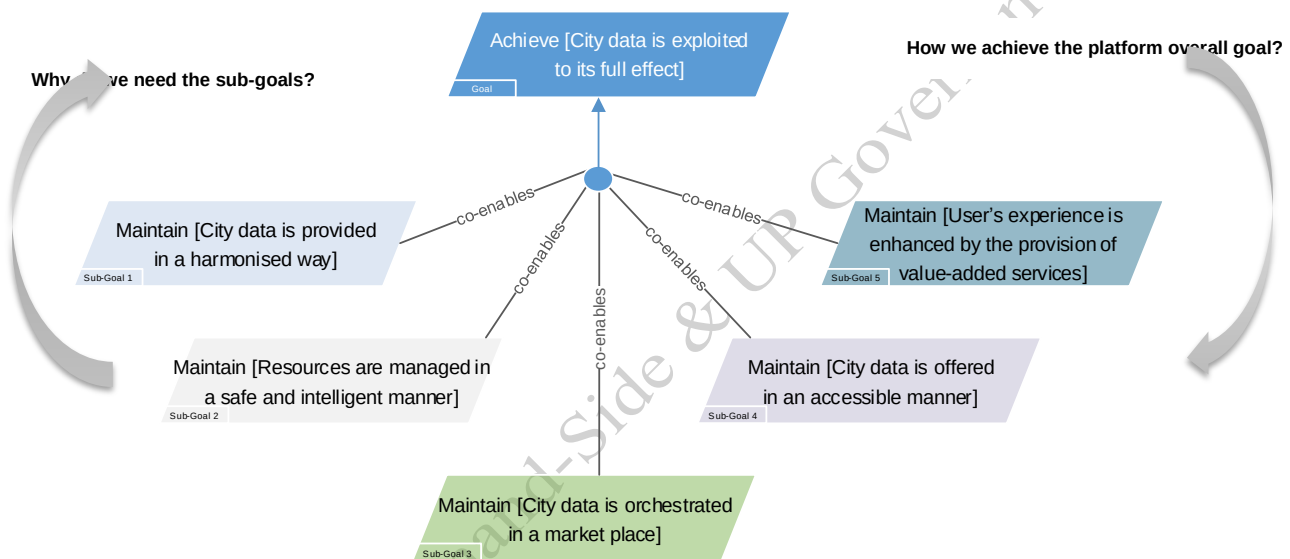


Figure 3. Platform High-Level Goal and its respective sub-goals.

2.2.1 Urban Platform Boundary

The use case diagram illustrated in Figure 4 identifies the boundaries between the actors (either automated or human) and the urban platform. We have arrived at the urban platform boundary by inspecting each business use case and determining, in conjunction with the stakeholders needs, which part of the business use case should be implemented and what part should be done by an outsourced product (e.g. Billing System) using the framework⁴.

This task is technology agnostic and takes into account the abilities of the users/actors, the constraints, the goals of the urban platform. Table 4 maps out the use cases with their respective sub-goals and actors.

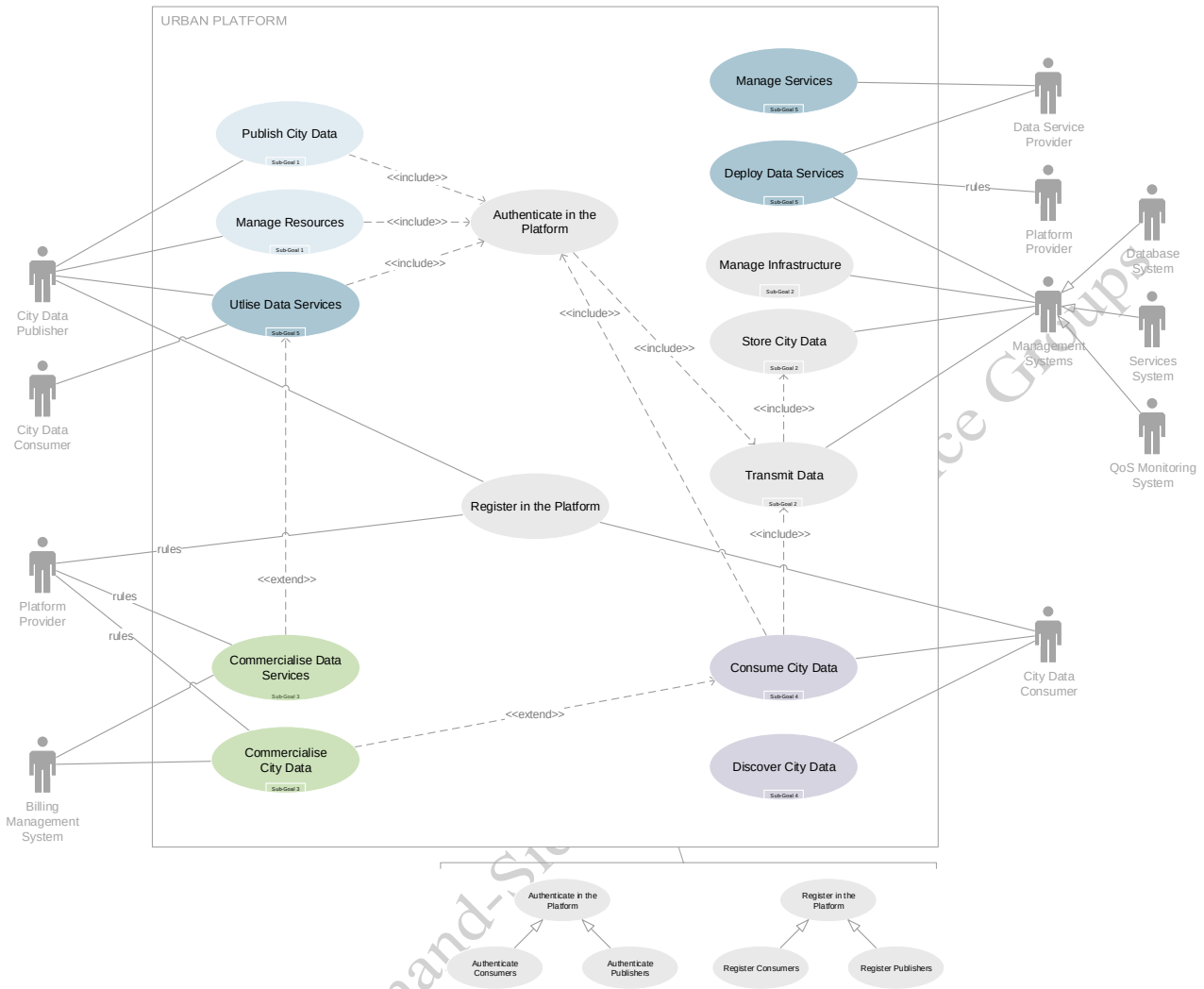


Figure 4. Simplistic overview of the use cases identified in the early stages of the platform design.

Table 4. Use Cases Mapping with Sub-Goals and Actors

	Sub-Goals	Use Cases	ID	Specialised Use Cases	Actors
HIGH-LEVEL GOAL: City data is exploited to its full effect	1. City data is provided in a harmonised way	Publish City Data	UC1	User publishes city data via data API's	City Data Publisher
		Register as a publisher in the Platform	UC2	User manually uploads datasets	
		Manage Resources	UC3	User manages resources	City Data Publisher
				User tracks resources usage	
	2. City data is managed in a safe and intelligent manner	Store City Data	UC4	-	Management Systems
		Transmit Data	UC5		
		Manage Infrastructure	UC6		

	3. City data is orchestrated in a market place	Commercialise City Data	UC7	Set commercial city data	City Data Publisher Platform Provider
				Subscribe to proprietary data	City Data Consumer
				Manage commercial data	City Data Publisher
				Manage data subscription	City Data Consumer
		Commercialise Data Services	UC8	Set commercial data services	Data Services Provider Platform Provider
				Subscribe to commercial services	Data Services Consumer
				Manage commercial services	Data Services Provider
				Manage services subscription	Data Services Consumer
	4. City data is offered in an accessible manner	Register in the Platform	UC9	-	City Data Consumer
		Discover City Data	UC10		City Data Consumer
		Consume City Data	UC11	User consumes city data via data API's	City Data Consumer
				User downloads datasets	
	5. User's experience is enhanced by the provision of value-added services	Deploy Data Services	UC12	-	Data Services Provider Platform Provider
		Manage Services	UC13		Data Services Provider
		Utilise Data Services	UC14		City Data Consumer

2.3 SUB-GOAL 1: City data is collected in an intelligent manner

Description: The urban platform enables the owners of city data to easily publish both historic and data streams in the platform, as well as their associated metadata.

Rationale: This sub-goal is maintained by the services and functions to accept the publication of city data from data providers (of both open and proprietary data) and prepare the contents for storage and management within the urban platform. Functions include receiving data, performing quality assurance on data, verifying data formatting and document standards, associating meta-data information, and coordinating updates to databases and resources management.

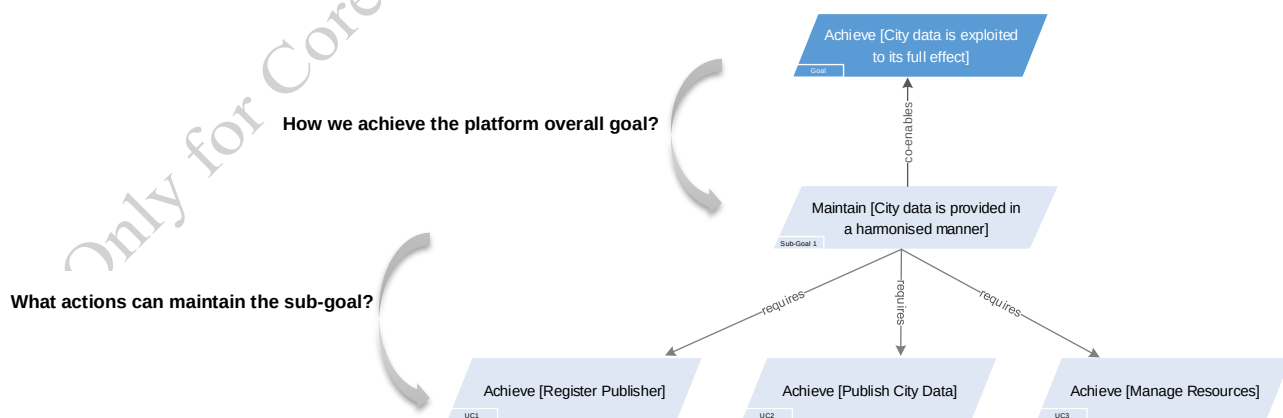


Figure 5. Sub-Goal 1 "City data is collected in an intelligent manner" refinement.

Drivers: Ensure data is published in an easy and uniform way.

Actions: For Sub-Goal 1 to be **maintained** in the long-run it requires the efficient realisation of use cases: “Publish City Data” and “Manage Resources”, as shown in Figure 5.

2.3.1 Use Case: Register Publisher

ID: UC1

Refines: SUB-GOAL 1: City data is collected in an intelligent manner

Pre-condition: Data Publisher is not logged in the system

Actors: Data Publishers

Rationale: Data Publishers can register in the platform and request approval to submit city data. They provide valid registration details (to be defined) and wait for registration confirmation. Platform Providers may authorise or not data publishers to offer both open and proprietary city data in the platform. Data submission agreement is a formal agreement between the Data Provider and the Urban Platform defining the terms of the content, standards, metadata creation, and license agreement. The Urban Platform will proactively work with Data Providers to agree on the content, quality and format of city data. Agreements between Platform and Data Providers may be renegotiated on a periodic or ad-hoc basis.

Refines into requirements: FREQ.1 to FREQ.5.

Use Case	Basic Stimulus and Responses
UC1. Register Publisher	1. The platform prompts the user for a username and password or register new account. 2. The user selects registration option. 3. The platform prompts user for publisher registration information (e.g. username, password, organisation) 4. The user enters in their information. 5. Platform verifies information and creates account. - o If non-valid information, platform shows error message and returns to step 1. 6. Platform provider is requested to approve the account - o Platform acknowledges registration has been successful - o If non approved, platform shows error message and returns to step 1. 7. End of registration

2.3.2 Use Case: Publish City Data

ID: UC2

Refines: SUB-GOAL 1 - City data is collected in an intelligent manner

Pre-condition: User is authenticated in the platform

Actors: City data publisher

Rationale: The Publish City Data function provides the appropriate mechanisms to receive city data from authorized data providers. Data may be manually uploaded or submitted via APIs. In general, data providers with whom the Urban Platform negotiates submission agreements are the providers of proprietary city data (those producing published material, i.e. publishers) and open data, and they can be either humans or machines. The providers of the Urban Platform will provide data providers with specifications on the content, quality and format of data, and publication terms and conditions.

The Publish City Data function may represent a legal transfer of custody for the data in the urban platform, and may require that special access controls be placed on the contents. This function provides a confirmation of receipt of data publication to the Producer, which may include a request to resubmit data in the case of errors resulting from the submission.

Once data has arrived, it must undergo several reviews, including virus checking, format compliance, metadata minimum requirement agreement, quality and anticipated content and data formatting. The platform must include the ability to record all actions and decisions made concerning the publication of city data. The reasons for publication failure (e.g. missing metadata information, non-valid dataset) will be provided back to the city data publisher. In some cases, the provider can then resubmit corrected data and metadata information, while in other instances data publication refusal criteria should prevent the publisher from submitting the same dataset at a later time period (e.g. in cases of suspicious datasets – copyrights violation, viruses). When data is successfully submitted (either via APIs or manual upload), it will be processed/prepared for storage into the platform's database.

Specialised Use Cases: The Use Case **Publish City Data** data is distinguished into two specialised Use Cases: “User publishes city data via data API’s (UC2.1)” and “User manually uploads datasets (UC2.2)”.

Subordinated Use Cases: “Store City Data (UC4)”

Refines into requirements: REQ 6 to REQ.26.

Specialised Use Cases	Basic Stimulus and Responses
UC2.1. User manually uploads datasets	1. Platform provides user with an interface for static data publication 2. User selects datasets to be uploaded 3. User provides metadata associated with the data (license, provenance, ownership, semantics) in accordance with defined standards 4. User requests data publication 5. Platform quickly process user's request for data publication 6. Platform validates data submitted - o If valid data, platform acknowledges data publication has been successful - o If non-valid data, platform shows error message and returns to step 1. 7. End of data publication
UC2.2. User publishes city data via data API's	1. Platform provides user with an interface for real-time data publication 2. User input data API information 3. User provides metadata associated with the data (license, provenance, ownership, semantics) in accordance with defined standards 4. User confirm information and request data publication 5. Platform quickly process user's request for data publication 6. Platform validates data submitted - o If valid data, platform acknowledges data publication has been successful - o If non-valid data, platform shows error message and returns to step 1 - End of data publication

2.3.3 Use Case: Manage Resources

ID: UC3

Refines: GOAL 1: City data is collected in an intelligent manner

Pre-condition: User successfully authenticates in the platform

Actors: City data publisher

Rationale: Manage resources provides the services and functions for updating, maintaining and accessing both data and metadata, as well as tracking the usage of resources by users. Ideally the owners of the resources should be the only authorised user to manage resources, and other authorised users can track the usage of the resources in the platform. The platform must provide a database update response indicating the status of the update, avoid update errors to be propagated in the platform, and should keep an audit trail of all actions to enable rollback. Data usage tracking includes performing queries on the data management data to generate result sets, and producing reports from these result sets.

Specialised Use Cases: The Use Case **Manage Resources** data is distinguished into two specialised Use Cases: “User manages resources (UC3.1)” and “User tracks resources usage (UC3.2)”.

Subordinated Use Cases: “Transmit Data (UC5)”

Refines into requirements: FREQ.27 to FREQ.25.

Specialised Use Cases	Basic Interactions and Responses
UC3.1. User manages resources	1. Platform provides user with an interface for resources management (e.g. data and metadata, data usage) 2. User chooses to edit or delete data 3. If edit, user revise metadata associated with the data (license, provenance, ownership, access-control, semantics); 4. If delete, user selects dataset(s) to be removed 5. User confirms action 6. Platform quickly process user's request 7. Platform confirms execution of request ○ If valid request, platform acknowledges request has been processed successfully ○ If non-valid request, platform returns to step 1. 8. End of resources management
UC3.2. User tracks resources usage	1. Platform provides user with an interface for resources management (e.g. data and metadata, data usage) 2. User chooses to visualise usage information of a dataset 3. Platform quickly process user's request for data usage information 4. Platform provides user with statistical information about data usage and data users anonymised information 5. End of data usage tracking.

2.3.4 Functional Requirements

Req. ID	UC. ID	Description	Priority	Domain
FREQ.1	UC1	Allow data publishers to register to submit data for publication	Must	Societal Needs, Platform
FREQ.2	UC1	Tracks data publication agreements between Data and Platform Providers	Must	Business Needs, Platform

FREQ.3	UC1	Store terms of agreements, and use them to monitor/review/process data submissions.	Must	City Data, Platform
FREQ.4	UC1	Able to add and edit terms of agreement, based on access of level of user.	Must	Business Needs, Platform
FREQ.5	UC1	Data publications are managed and monitored	Must	City Data, Platform
FREQ.6	UC2	Allow authenticated users from across different organisations to publish city data	Must	City Data, Platform, Business Needs
FREQ.7	UC2	Provide authorization mechanisms for users and sensors to publish city data	Must	City Data, Platform
FREQ.9	UC2	Provide mechanisms for static data publication	Must	City Data, Platform, Business Needs
FREQ.10	UC2	Provide mechanisms for real-time data publication	Must	City Data, Platform, Business Needs
FREQ.11	UC2	Enable the publication of metadata	Must	City Data, Platform
FREQ.12	UC2	Maintain temporal information about the data	Must	City Data, Platform
FREQ.13	UC2	Support sensory data collection	Must	City Data, Platform
FREQ.14	UC2	Accepts content in numerous file types/formats	Must	City Data, Platform
FREQ.15	UC2	Prompts a request for resubmission to the data provider if an error of data transmission or receipt occurs	Must	City Data, Platform
FREQ.16	UC2	Enable the semantic description of connected devices	Must	City Data, Platform
FREQ.17	UC2	Gather data from authenticated and authorized devices	Must	City Data, Platform
FREQ.18	UC2	Validates automatically the successful transfer of the data	Must	City Data, Platform
FREQ.19	UC2	Performs virus checking on data	Must	City Data, Platform
FREQ.20	UC2	Verifies the validity of the submission based on submitter, expected format, data quality, and completeness	Must	City Data, Platform
FREQ.21	UC2	Platform should have built-in checks on the incoming metadata. Data not containing the minimally defined set of attributes should be returned to the publisher for metadata enhancement.	Must	City Data, Platform
FREQ.22	UC2	System should have a user-friendly method of mapping non-standard metadata elements into approved standard elements.	Should	City Data, Platform
FREQ.23	UC2	Once ingested, metadata should be stored in a single common format. This format should be one that ensures against data loss, and allows a variety of access/distribution options	Must	City Data, Platform
FREQ.24	UC2	Data in the repository shall have sufficient technical metadata to assure functionality (e.g. viewing and display) to ensure accessibility and reusability.	Must	City Data, Platform
FREQ.25	UC2	Allows publishers to display and perform manual/visual quality control assurance via a user-friendly GUI	Could	Business Needs, City Data, Platform
FREQ.26	UC2	Any errors shall prompt a request for resubmission of data	Should	Business Needs, City Data, Platform
FREQ.27	UC3	Enable data providers to manage their resources	Must	Business Needs
FREQ.28	UC3	A minimal set of identifying information/metadata concerning data publication submission must be recorded	Must	Business Needs, Platform

FREQ.29	UC3	Stores and tracks versions of data. Links /connections between versions are created and maintained	Must	City Data, Platform
FREQ.30	UC3	Give service and data providers access to anonymized data of the subscribers of their data or services	Should	Business Needs
FREQ.31	UC3	Enable data providers to maintain and repair data and metadata	Should	City Data, Platform, Business Needs
FREQ.32	UC3	Tracks data publication agreements between Data and Platform Providers	Must	Business Needs, Platform
FREQ.33	UC3	Store terms of agreements, and use them to monitor/review/process data submissions.	Must	City Data, Platform
FREQ.34	UC3	Able to add and edit terms of agreement, based on access of level of user.	Must	Business Needs, Platform
FREQ.35	UC3	Submission volumes and schedules are managed and monitored	Must	City Data, Platform

2.4 SUB-GOAL 2: City data is managed in a safe and intelligent manner

Rationale: The urban platform enables users to publish, consume and commercialise data, as well as deploy and manage services all in a secure and privacy protected manner.

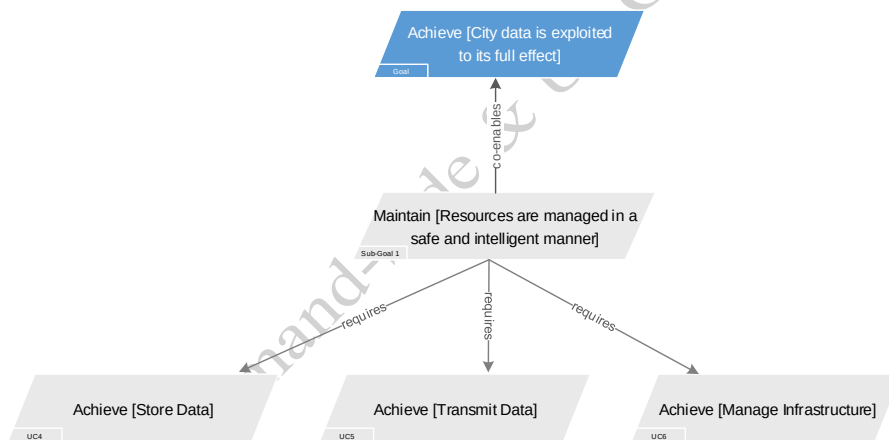


Figure 6. Sub-Goal 2 "City data is managed in a safe and intelligent manner" refinement.

Drivers: Ensure data is secured and the identity of users are preserved

Actions: For Sub-Goal 2 to be maintained in the long-run it requires the efficient realisation of use cases: "Store City Data" and "Retrieve and Transmit City Data", as shown in Figure 6.

2.4.1 Use Case: Store City Data

ID: UC4

Refines: SUB-GOAL 2: City data is managed in a safe and intelligent manner

Pre-condition: Data is successfully published in the platform

Actors: Urban Platform

Rationale: When data is successfully submitted (either via APIs or manual upload), it is processed/prepared for storage into the platform's database. This procedure will include the

generation of unique identifiers to the database, enrichment with ontologies (when applicable), encrypted (when applicable), signed with digital certificates (when applicable) to ensure that the data conforms to the platform data formatting, standards, security and regulation. Data may be converted to accepted formats, as needed (e.g. graph model). A primary goal of the conversion of content for the platform is the preservation of the content. Priority will be given to preserving the data accordingly to the policies defined in section (2.6.2). Access-control levels and license models are associated to data which is subject to restrictions relating to access and conditions of use.

Refines into requirements: FREQ 28 – FREQ 39.

Use Case	Basic Interactions and Responses
UC4. Store City Data	1. Platform mechanisms converts submitted data into a standard format 2. Security enforcement (e.g. anonymisation, cryptography) is placed on sensitive information. 3. Platform associates with datasets the access-control definitions set by owner of resources. 4. Data is enriched with semantics and is associated with other datasets 5. Platform stores data in a scalable and secure database. 6. End of data storage.

2.4.2 Use Case: Transmit Data

ID: UC5

Refines: SUB-GOAL 2: City data is managed in a safe and intelligent manner

Pre-condition: Data is successfully published in the platform

Actors: Urban Platform

Rationale: The platform accepts data retrieval request, validates user's rights to access the data, retrieves city data from data storage, and moves a copy of the data to the relevant platform component for further processing. If special processing is required, the retrieval function accesses data in staging storage and applies the requested processes. The types of operations, which may be carried out, include sub-sampling in temporal or spatial dimensions, conversions between different data types or output formats, and other specialized processing (e.g., data visualisation). Once it is finalised data will be sent to the appropriate delivery channels (e.g. API's, GUI). It also encompasses function to verify corruption during any internal data transfer. This function requires that all hardware and software within the platform provide notification of potential errors and that these errors are routed to standard error logs that are checked by the Platform Provider.

Refines into requirements: FREQ 40 to 54.

2.4.3 Use Case: Manage Infrastructure

ID: UC6

Refines: SUB-GOAL 2: City data is managed in a safe and intelligent manner

Pre-condition: The platform is available

Actors: Urban Platform

Rationale: Manage infrastructure provides the services and functions for the overall operation of the urban platform. Administration functions include monitoring quality of service agreements, auditing data publication to ensure that they meet archive standards, and maintaining configuration management of system hardware and software. In overall, it provides system engineering functions to monitor and improve platform operations, and to inventory, report on, and migrate/update the contents of the platforms' databases.

Refines into requirements: FREQ 55 to 62.

Use Case	Basic Interactions and Responses
UC6. Manage Infrastructure	- Platform keeps monitoring services at run-time to ensure operation and integrity of city data - If system failure, the platform activates mechanisms for recovery based on pre-defined rules - Platform logs issue and issue alert messages to platform providers - Platform logs operation capabilities (e.g. performance, mean of time failure, issues, etc.)

2.4.4 Functional Requirements

Req. ID	UC. ID	Description	Priority	Domain
FREQ.28	UC4	A minimal set of identifying information/metadata concerning data publication submission must be recorded.	Must	Business Needs, Platform
FREQ.29	UC4	Stores and tracks versions of data. Links /connections between versions are created and maintained.	Must	City Data, Platform
FREQ.30	UC4	Converts data to accepted file formats	Must	City Data, Platform
FREQ.31	UC4	Keep sensitive information secured and accessible only to authorized users	Must	City Data, Platform
FREQ.32	UC4	Keep user's personal information protected	Should	City Data, Platform
FREQ.33	UC4	Keep city data and meta-data secured	Must	Platform Needs
FREQ.34	UC4	Enable privacy preserving mechanisms associated to data	Must	Platform Needs
FREQ.35	UC4	Model data in accordance with defined standards	Must	City Data, Platform
FREQ.36	UC4	Support the use of ontologies and semantic modelling of city data	Could	City Data
FREQ.37	UC4	Support database-level provenance annotation	Should	City Data
FREQ.38	UC4	Support data-level provenance annotation	Should	City Data
FREQ.39	UC4	Enable data to be encrypted	Should	Platform Needs
FREQ.40	UC5	System must have the ability to search and display metadata, preferably in a user-conformable, human readable display as well as in its native format for machine harvesting and manipulation.	Must	City Data, Platform Needs
FREQ.41	UC5	Controls access to data in the repository based on multiple permission levels. These permission levels determine the create/edit/read/delete privileges granted users.	Should	City Data, Platform Needs
FREQ.42	UC5	Access rights and conditions of use will be held for each data and its related metadata.	Should	City Data, Platform Needs
FREQ.43	UC5	Access rights and conditions can be inherited from a parent data to any data designated as a child data (derived information).	Could	City Data, Platform Needs
FREQ.44	UC5	Access rights and conditions of use will be machine readable and actionable.	Should	City Data, Platform Needs
FREQ.45	UC5	Access mechanisms must be sufficiently granular to allow the identification of individual users, in order to maintain audit logs of actions performed by users.	Should	Business Needs, City Data, Platform

FREQ.46	UC5	Maintains the integrity of the database which contains both metadata and system information.	Must	Platform Needs
FREQ.47	UC5	Provides internal validation such as referential integrity of the contents of the database.	Must	City Data, Platform Needs
FREQ.48	UC5	Creates and maintains schema definitions required to support data management functions.	Must	Platform Needs
FREQ.49	UC5	Monitors and ensures that data and metadata are not corrupted during transfers.	Must	Platform Needs
FREQ.50	UC5	Provides statistically acceptable assurance that no components of the data are corrupted during any internal data transfer.	Must	Platform Needs
FREQ.51	UC5	Performs routine and special data integrity checking for each dataset and generates error reports.	Must	Platform Needs
FREQ.52	UC5	Provides disaster recovery capabilities including data backup, off-site data storage, data recovery, etc.	Must	Platform Needs
FREQ.53	UC5	Refresh/replace data without service interruption, and update corresponding metadata as appropriate.	Must	Platform Needs
FREQ.54	UC5	Ensure that any associated unique identifiers of the updated data are not altered.	Must	Platform Needs
FREQ.55	UC6	Audits submissions to ensure that they meet archive/repository standards.	Must	Platform Needs
FREQ.56	UC6	Maintains configuration management of the system hardware and software.	Must	Platform Needs
FREQ.57	UC6	Has capability to inventory, report on and migrate the contents of the repository.	Must	Platform Needs
FREQ.58	UC6	Ensures data integrity for version upgrades and format migration.	Must	Platform Needs
FREQ.59	UC6	Monitors functionality of the entire repository.	Must	Platform Needs
FREQ.60	UC6	Maintains integrity of system configuration.	Must	Platform Needs
FREQ.61	UC6	Audits system operations, performance and usage.	Must	Platform Needs
FREQ.62	UC6	Provides platform performance information and database holdings inventory reports	Must	Platform Needs

2.5 SUB-GOAL 3: City data is orchestrated in a marketplace

Rationale: The urban platform enables users to consume and publish data in a secure and privacy protected manner.

Drivers: Ensure data is secured and the identity of users are preserved

Actions: For Sub-Goal 3 to be maintained in the long-run it requires the efficient realisation of use cases: “Commercialise City Data” and “Commercialise Data Services”, as shown in Figure 7.

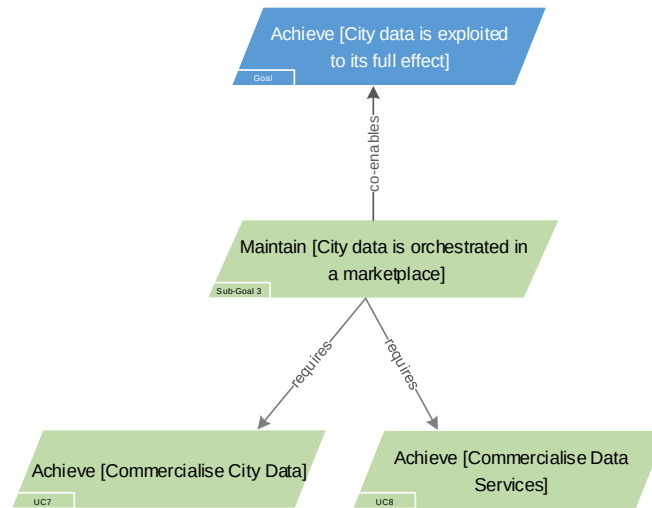


Figure 7. Sub-Goal 3 “City data is orchestrated in a marketplace” refinement.

2.5.1 Use Case: Commercialise City Data

ID: UC7

Refines: SUB-GOAL 3: City data is orchestrated in a marketplace

Pre-condition: Data is successfully published in the platform, both publisher and consumers of city data are authenticated in the platform, and there are billing capabilities available.

Actors: Data Publishers, Data Consumers

Rationale: The providers of city data can commercialise city data based on the policies and financial models defined in the platform. After publishing their data, publishers can define which data can be available as open data and which data should be available with the payment of a subscription fee. Once publishers define which data is to be commercially exploited, the platform will associate the data with their respective financial models and let it ready for subscription. City data consumer chooses which data to purchase and is redirected to a billing interface where the subscription payment is taken. The platform must provide an update response indicating the status of the payment. If successful, data is ready available to be consumed by humans and machines, otherwise the user can re-try the payment or cancel transaction.

Commercialise city data also involves the function of managing commercial data. It provides services and functions for updating, maintaining and accessing both data and its respective commercial transactions. Furthermore, it enables data providers to track the usage of commercial data by users. Ideally the owners of the data should be the only authorised user to manage resources, and other authorised users can track the usage of the data in the platform. Data usage tracking includes performing queries on the data management data to generate result sets, and producing reports from these result sets. Data consumers are provided with functions which enable them to manage their subscriptions and financial transactions on the platform. These functions include updating, maintaining and accessing financial transactions. For all these functions and services, the platform must provide a database update response indicating the status of the update, avoid update errors to be propagated in the platform, and should keep an audit trail of all actions to enable rollback.

Specialised Use Cases: The Use Case **Commercialise City Data** is distinguished into four specialised Use Cases: “Commercialise Data (UC7.1)”, “Consume Commercial City Data (UC7.2)”, “Manage Commercial Data (UC7.3)” and “Manage Data Subscription (UC7.4)”.

Refines into requirements: FREQ 63 to 68.

Use Case	Basic Interactions and Responses
UC7.1. Commercialise Data	1. User selects the data to be commercialised 2. User selects the commercial model for data consumption 3. Platform validates selection 4. Platform associates data to subscription model 5. Platform releases data for commercial exploitation in the marketplace 6. End of data commercialisation set up.
UC7.2. Consume Proprietary Data	1. User selects the data to be subscribed to 2. User request subscription to data 3. Platform validates selection 4. Platform redirects user to billing system 5. Billing system deals with user request ○ If successful, user is redirected to a GUI where data is ready to use ○ If unsuccessful, user can try payment again or cancel request 2. End of data subscription.
UC7.3. Manage commercial Data	1. Platform provides user with an interface for commercial data management 2. User chooses to edit or delete commercial data ○ If edit, user revise commercial models, licenses, access-control, semantics; ○ If delete, user selects dataset(s) to be removed (following policies defined in the platform for data removal) 3. User confirms action 4. Platform promptly process user's request 5. Platform confirms execution of request ○ If valid request, platform acknowledges request has been processed successfully ○ If non-valid request, platform returns to step 1. 6. End of resources management
UC7.4. Manage data subscription	1. Platform provides user with an interface for data subscription management 2. User chooses to edit or cancel data subscription ○ If edit, user revise payment and subscription timeframe; ○ If cancel, user selects dataset(s) to have subscription cancelled (following policies defined in the platform for data subscription) 3. User confirms action 4. Platform promptly process user's request 5. Platform confirms execution of request ○ If valid request, platform updates acknowledges request has been processed successfully ○ If non-valid request, platform returns to step 1. 6. End of data subscription management

2.5.2 Use Case: Commercialise Data Services

ID: UC8

Refines: SUB-GOAL 3: City data is orchestrated in a marketplace

Pre-condition: Data is successfully published in the platform, both publisher and consumers of city data are authenticated in the platform, and there are billing capabilities available.

Actors: Data Service Providers, Data Publishers and Consumers

Rationale: After deploying data services in the platform, the providers of data services can choose to commercialise services based on the policies and financial models defined in the platform. Once data service providers define which service(s) is (are) to be commercially exploited, the platform will associate the services with their respective financial models and let available in the platform applications module ready for use. User (either publisher or consumer) chooses which data services to use, and in case a charged service is selected the platform redirects the user to a billing interface where the payment is taken. The platform must provide an update response indicating the status of the payment. If successful, service is ready available to be used, otherwise the user can re-try the payment or cancel transaction. Note that data service owners should be able to waive the payment of tariff to certain users' categories.

Data services providers are offered with functions to manage their commercial services. The platform provides functions for updating, maintaining and accessing both service and its respective commercial transactions. Furthermore, it enables data services providers to track the usage of services by users. Services usage tracking includes performing queries on the platform to generate result sets, and producing reports from these result sets. The consumers of data services are provided with functions which enable them to manage their subscriptions and financial transactions. These functions include updating, maintaining and accessing financial transactions. For all these functions and services, the platform must provide a database update response indicating the status of the update, avoid update errors to be propagated in the platform, and should keep an audit trail of all actions to enable rollback.

Specialised Use Cases: The Use Case **Commercialise Data Services** is distinguished into four specialised Use Cases: "Commercialise Data Services (UC8.1)", "Consume Data Services (UC8.2)", "Manage Commercial Services (UC8.3)" and "Manage Services Subscription (UC8.4)".

Refines into requirements: FREQ 68 to 73.

Use Case	Basic Interactions and Responses
UC8.1. Commercialise Data Services	1. User selects the data services to be commercialised 2. User selects the commercial model for data service usage based on the category of users 3. Platform validates selection 4. Platform associates data services to subscription model 5. Platform enables data service to be commercially exploited in the marketplace 6. End of services commercialisation set up.
UC8.2. Consume Data Services	1. User selects the data service to be subscribed to 2. User request subscription to service 3. Platform validates selection 4. Platform validates user's category its respective commercial models 4. If applicable, platform redirects user to billing system 5. Billing system deals with user's request - o If successful, user is redirected to a GUI where data is ready to use - o If unsuccessful, user can try payment again or cancel request 6. End of data subscription.

<i>UC8.3. Manage commercial services</i>	1. Platform provides user with an interface for commercial data management 2. User chooses to edit or delete commercial data ○ If edit, user revise commercial models, licenses, access-control, semantics; ○ If delete, user selects dataset(s) to be removed (following policies defined in the platform for data removal) 3. User confirms action 4. Platform promptly process user's request 5. Platform confirms execution of request ○ If valid request, platform acknowledges request has been processed successfully ○ If non-valid request, platform returns to step 1. 6. End of resources management
<i>UC8.4. Manage services subscription</i>	1. Platform provides user with an interface for data subscription management 2. User chooses to edit or cancel data subscription ○ If edit, user revise payment and subscription timeframe; ○ If cancel, user selects dataset(s) to have subscription cancelled (following policies defined in the platform for data subscription) 3. User confirms action 4. Platform promptly process user's request 5. Platform confirms execution of request ○ If valid request, platform updates acknowledges request has been processed successfully ○ If non-valid request, platform returns to step 1. 6. End of data subscription management

2.5.3 Functional Requirements

Req. ID	UC. ID	Description	Priority	Domain
FREQ.63	UC7	Support the commercialization of city data	Should	City Data, Platform, Business Needs
FREQ.64	UC7	Enable users to subscribe to city data through the payment of a tariff	Should	City Data, Platform, Business Needs
FREQ.65	UC7	Enable users to manage their data subscriptions	Should	City Data, Platform, Business
FREQ.66	UC7	Provide platform providers mechanisms to define the terms and conditions for platform data usage	Must	Platform Needs
FREQ.67	UC7	Enable data providers to manage the subscription models of their data	Should	City Data, Platform, Business
FREQ.68	UC7/ UC8	Utilise secure and reliable billing and payment management systems	Must	City Data, Platform, Business
FREQ.69	UC8	Support the commercialization of data services	Should	City Data, Platform, Business Needs
FREQ.70	UC8	Enable data providers to manage the commercial models of their services	Should	City Data, Platform, Business Needs
FREQ.71	UC8	Provide service providers mechanisms to define the terms and conditions of platform services	Should	City Data, Platform, Business Needs
FREQ.72	UC8	Allow users to pay a tariff for using certain advanced services (e.g. Data manipulation, enrichment)	Should	City Data, Platform, Business Needs
FREQ.73	UC8	Enable users to manage their data services subscriptions	Should	City Data, Platform, Business Needs

2.6 SUB-GOAL 4: City data is offered in an accessible manner

Rationale: The urban platform provides city data in both human and machine (e.g. sensors, actuators, systems) readable and understandable formats.

Drivers: Ensure data understandability and machine-to-machine data transaction.

Actions: For Sub-Goal 3 to be maintained in the long-run it requires the efficient realisation of use cases: “Register Consumer”, “Discover City Data”, and “Consume City Data” as shown in Figure 8.

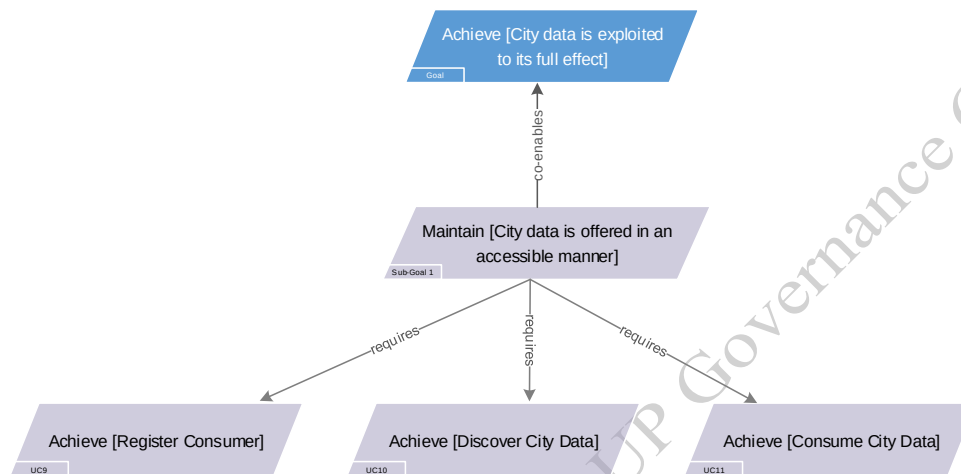


Figure 8. Sub-Goal 4 “City data is offered in an accessible manner” refinement.

2.6.1 Use Case: Register Data Consumer

ID: UC9

Refines: SUB-GOAL 4: City data is offered in an accessible manner

Pre-condition: User is not logged in the platform

Actors: Data Consumers

Rationale: Data Consumers can register in the platform and request approval to consume city data via GUI or APIs. They provide valid registration details (to be defined) and wait for platform to confirm their registration. Users must accept the terms and conditions of platform usage and define how their personal data can be used by the Platform Owner. Users can manage and alter their registration information at any time they want to.

Refines into requirements: FREQ 64.

Use Case	Basic Stimulus and Responses
UC1. Register Consumer	1. The platform prompts the user for a username and password or register new account. 2. The user selects registration option. 3. The platform prompts user for data consumer registration information 4. The user enters in their information. 5. Platform verifies information and creates account. - o If non-valid information, platform shows error message and returns to step 1. 6. Platform acknowledges registration has been successful 7. End of registration

2.6.2 Use Case: Discover City Data

ID: UC10

Refines: SUB-GOAL 4: City data is offered in an accessible manner

Pre-condition: User has access to either platform GUI or API

Actors: Data Consumers

Rationale: Data Consumers can register in the platform and request approval to consume city data via GUI or APIs. They provide valid registration details (to be defined) and wait for platform to confirm their registration.

Refines into requirements: FREQ 64.

Use Case	Basic Stimulus and Responses
<i>UC10.1</i> Discover city data via data query end-points	1. Users access specialised data query end-points (e.g. SPARQL) 2. Users provides information for pre-defined parameters for search 3. Users request data search 4. Platform quickly process users request for data - o All queries are verified against access rights restrictions - o If restriction applies users are redirected to log in interfaces - o Users provide credentials and log on the system 5. Users are provided with query results on the end-point if access is allowed - o If access is not not allowed platform issues an error message to the user
<i>UC10.2</i> Discover city data via data query end-points	1. Users search city data via GUI 2. Users inputs search parameters (e.g. key words, categories, formats, publishers) 3. Users request data search 4. Platform quickly process users request for data - o All queries are verified against access rights restrictions - o If restriction applies users are redirected to log in interfaces - o Users provide credentials and log on the system 5. Users are provided with query results on an interface - o If access is not allowed platform issues an error message to the user

2.6.3 Use Case: Consume City Data

ID: UC11

Refines: SUB-GOAL 4: City data is offered in an accessible manner

Pre-condition: User has access to either platform GUI or API

Actors: Data Consumers

Rationale: Data Consumers can register in the platform and request approval to consume city data via GUI or APIs. They provide valid registration details (to be defined) and wait for platform to confirm their registration.

Refines into requirements: FREQ 64.

Subordinated Use Cases: "Consume proprietary city data"

Use Case	Basic Stimulus and Responses
<i>UC11.1 Customise City Data</i>	1. Users request data to be formatted in a particular format supported by the platform 2. Platform quickly process users request for data formatting 3. Mechanism for data conversion is called and process data 4. Users are provided with data formatted as requested
<i>UC11.2 Consume City Data via GUI</i>	1. Users / Machines select data to be downloaded 2. Users / Machines are redirected to authentication mechanism in case of registration is needed for the particular dataset - o If authentication is successful, users are provided with requested data streams 3. Users are provided with requested data via APIs
<i>UC11.3 Consume City Data via APIs</i>	1. Users / Machines makes data request on the platforms API 2. Users / Machines are redirected to authentication mechanism in case of registration is needed for the particular dataset - o If authentication is successful, users are provided with requested data streams 3. Users are provided with requested data via APIs

2.6.4 Functional Requirements

Req. ID	UC. ID	Description	Priority	Domain
FREQ.74	UC9	Allow users to register to use services and consume proprietary city data and open data (optional)	Should	Societal Needs, Platform
FREQ.75	UC9	Keep sensitive information secured and accessible only to authorized users	Should	Societal Needs, Platform
FREQ.76	UC9	Provide authentication mechanisms for users	Must	Societal Needs, Platform
FREQ.77	UC9	Keep user's personal information protected	Must	Societal Needs, Platform
FREQ.78	UC9	Allow users to control which data they are willing to provide and how their data should be used	Must	Societal Needs, Platform
FREQ.79	UC10	Allow users to format data in any supported data formats	Must	Societal Needs, Platform
FREQ.80	UC10	The query request may require data to be sourced from different storage locations	Must	Societal Needs, Platform
FREQ.81	UC10	Allows query requests against all metadata used to manage the repository.	Should	Societal Needs, Platform
FREQ.82	UC11	Provide users information about the legal aspects of the data (license, ownership)	Must	Societal Needs, City Data
FREQ.83	UC11	Keeps an audit trail of all actions.	Must	Societal Needs, City Data

2.7 SUB-GOAL 5: User's experience is enhanced by the provision of value-added services

Rationale: The urban platform enables users to consume and publish data in a secure and privacy protected manner

Drivers: Ensure data is secured and the identity of users are preserved

Actions: For Sub-Goal 5 to be maintained in the long-run it requires the efficient realisation of use cases: "Deploy Data Services", "Manage Services", and "Utilise Data Services" as shown in Figure 8.

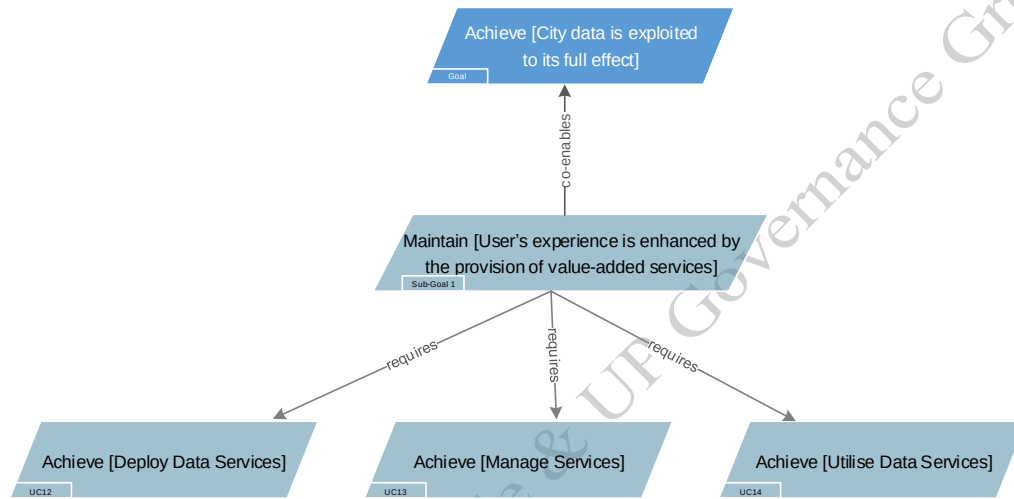


Figure 9. Sub-Goal 5 "User's experience is enhanced by the provision of value-added services" refinement

2.7.1 Deploy Data Services

ID: UC12

Refines: SUB-GOAL 5: User's experience is enhanced by the provision of value-added services

Pre-condition: Data Services Providers are provided with credentials, are authorised to deploy their services in the platform, and have access to technical specifications of the platform interfaces.

Actors: Data Services Providers

Rationale: Data Services can register in the platform and request approval to deploy services in the platform. They provide valid registration details (to be defined) and wait for registration confirmation. Platform Providers may authorise or not data services providers to offer both open and proprietary services in the platform. Data services providers must formally agree with service deployment agreement with the Urban Platform. This agreement defines terms of the content, policies, regulations, license agreement. The Urban Platform will proactively work with Service Providers to agree on the technical specifications of interfaces and platform openness level. Agreements between Platform and Data Service Providers may be renegotiated on a periodic or ad-hoc basis.

Refines into requirements: FREQ.1 to FREQ.5.

Use Case	Basic Stimulus and Responses
UC12. Deploy Services	1. User authenticates in the platform 2. User is provided access to platform interfaces for service deployment 3. User deploy services 4. Platform checks compatibility and any technical issues arising from the new service 5. If approved the service is ready to be used and managed in the platform ○ If deployment is not approved, platform shows error message and returns to step 1. 6. End of deployment

2.7.2 Use Case: Manage Services

ID: UC13

Refines: GOAL 5: User's experience is enhanced by the provision of value-added services

Pre-condition: User successfully authenticates in the platform

Actors: Data Services Providers

Rationale: Manage services provides the functions for updating, maintaining and accessing services as well as tracking their usage by users. Ideally the owners of the services should be the only authorised user to manage them, and other authorised users can track the usage of the services in the platform. In case of updates the platform must log in the database update details and send to service providers a response indicating the status of the update. The platform should also ensure update errors are not propagated nor affect the health of other services provided in the platform, and should keep an audit trail of all actions to enable rollback. Data services usage tracking includes performing queries on the data management data to generate result sets, and producing reports from these result sets. All user's information provided to service providers must follow regulations of data protection and the user's defined rules for their data use.

Specialised Use Cases: The Use Case **Manage Services** is distinguished into two specialised Use Cases: "User manages services (UC13.1)" and "User tracks service usage (UC13.2)".

Subordinated Use Cases: "Transmit Data (UC5)"

Refines into requirements: FREQ.27 to FREQ.25.

Specialised Use Cases	Basic Interactions and Responses
UC13.1. User manages services	1. Platform provides user with an interface for services management 2. User chooses to edit or delete services 3. If edit, user revise service information (access-control, commercial models, parameters) and deployment; If delete, user selects services to be removed / disabled 4. User confirms action 5. Platform quickly process user's request 6. Platform confirms execution of request ○ If valid request, platform acknowledges request has been processed successfully ○ If non-valid request, platform returns to step 1. 7. End of services management

UC13.2. User tracks services usage	1. Platform provides user with an interface for services management 2. User chooses to visualise usage information of a service 3. Platform quickly process user's request for data usage information 4. Platform provides user with statistical information about services usage and data users anonymised information 5. End of data services tracking.
------------------------------------	---

2.7.3 Use Case: Utilise Data Services

ID: UC2

Refines: SUB-GOAL 1 - City data is collected in an intelligent manner

Pre-condition: User is authenticated in the platform

Actors: City data publisher

Rationale: Data Consumers can register in the platform and request approval to consume city data via GUI or APIs. They provide valid registration details (to be defined) and wait for platform to confirm their registration.

Subordinated Use Cases: "Commercialise Data Services (UC8)"

Refines into requirements: FREQ 6 to FREQ.26.

Specialised Use Cases	Basic Interactions and Responses
UC2.1. User utilises data services	1. Users / Machines select data service to be utilised 2. Users / Machines are redirected to authentication mechanism in case of registration is needed for the particular service - o If authentication is successful, users are provided with requested data streams 3. Users are provided with requested service either via API or GUI

2.7.4 Functional Requirements

Req. ID	UC. ID	Description	Priority	Domain
FREQ.84	UC12	Provide stable and well-defined interfaces to ensure interoperability between the platform, services and the applications provided by services providers	Should	Societal Needs, Platform
FREQ.85	UC12	Ensure the interfaces of the architecture are open to reduce entry barriers and integration issues	Should	Societal Needs, Platform
FREQ.86	UC12	Provide multi-purposed and network intelligent interfaces to providers and consumers of services	Must	Societal Needs, Platform
FREQ.87	UC12	Provide service providers mechanisms to define the terms and conditions of platform services deployment	Must	Societal Needs, Platform
FREQ.88	UC13	Provide statistical information of user's feedback on service usage	Must	Business Needs, Platform
FREQ.89	UC10	Allow users to use services to manipulate city data (e.g. Create mash ups, integrate)	Must	Societal Needs, Platform
FREQ.90	UC14	Allow users to provide feedback on usability, and quality of data and services provided by the platform	Must	Societal Needs, Platform

3. Non-functional Requirements

3.1 Run-time Quality Requirements

3.1.1 Scalability Requirements

Rationale: The ability of the system to execute its task within its expected performance profile and to handle on-demand increased processing volumes of data and service requests

Drivers: Provide ready access to all data that underpins decision making processes in smart cities, and accommodate users and data usage patterns

Refines into requirements: NFREQ.1, NFREQ.2, NFREQ.3, NFREQ.4

Relevance: Urban platforms have ambitious performance requirements. Such platforms must cope with user's demand for data and services, capture real-time data that will be catalysed by a myriad of sensors. The demand for urban platform is very likely to significantly increase over time. It is very difficult to have clear performance characteristics due to the ubiquity, heterogeneity high connectivity of devices and end users.

SCALABILITY MEASURES	
Actions	Capture the performance requirements Create service level agreements Predict scalability using software simulation Analyse the performance of the platform overtime Conduct practical testing
Strategy	Prioritize service and data requests Distribute processing over time Scale up or scale out as necessary Reuse resources and results Partition and parallelize Constantly monitor Quality of Service at runtime

3.1.2 Availability and Reliability Requirements

Rationale: The ability of the system to be fully or partly operational as and when required and to effectively handle failures that could affect system availability

Drivers: Build a reliable foundation for “on demand” exploitation of data

Refines into requirements: NFREQ.5, NFREQ.6, NFREQ.7, NFREQ.8

Relevance: Any system that has complex or extended availability requirements, complex recovery processes, or a high profile (e.g., is visible to the public)

AVAILABILITY AND RELIABILITY MEASURES	
Actions	Capture the availability requirements Produce the availability schedule Estimate platform availability Estimate functional availability Assess against the requirements Rework the architecture
Strategy	Adopt fault-tolerant hardware Use reliable infrastructure database Log transactions

	Develop adaptive software to cope and recover from faults Design and test for failure Deploy load balancing Identify suitable backup and disaster recovery solution
--	--

3.1.3 Trust Requirements

Rationale: A quality related to the user's belief in the reliability, integrity and ability of the functional behaviour of the platform

Drivers: Gain understanding of what influences user's experience while interacting with services provided

Requirements: NFREQ.16, NFREQ.17

Relevance: Relevant to the systems that share and collect information that may raise public concern. In some cases, trust has to do with the reliability of data and their providers, whereas in other cases trust can be associated with the security and privacy of the technology that was deployed. Trust affects the reputation of the platform besides its dissemination and maturity on the market.

TRUST MEASURES	
Actions	Capture trust requirements Perform risk analysis so measures can be implemented Explore the vulnerability aspects of city data Check whether extensibility requirements impact on trust Define a trust model
Strategy	Adopt trust model Deploy monitoring capabilities and assess its impact on scalability Manage the data in a way that ensures its compliance with data protection regulations Implement tampering and data misuse detection Make use of Cryptography when necessary Allow Federation of trust between platforms

3.1.4 Security Requirements

Rationale: Ability of the system to enforce the intended confidentiality, trust, integrity and service and data access policies, and to detect and recover from failure in these security mechanisms.

Drivers: Manage the data and services in a way that ensures its integrity, and compliance with data protection regulations

Relevance: Relevant to the systems that share and collect information that may raise public concern. Urban platforms may become a valuable target for attackers which can potentially leave huge swathes of information exposed. It could potentially undermine trust in the government and damage its reputation.

Refines into requirements: NFREQ.9 to NFREQ.15

SECURITY MEASURES	
Actions	- Elicit the security requirements - Cross-check security requirements' impact on services offered by different providers - Verify security impact on service composition - Conduct risk analysis and impacts of security breach - Use scalable and efficient user authentication components - Use authentication and authorization components to secure interfacing with external services - Address aspects of data collection, storage and distribution - Address aspects of service and communication security among devices - Identify security requirements of the physical infrastructure - Balance and prioritize scalability (performance) and security requirements - Evaluate trade-offs between privacy considerations and preventing abuse. (While anonymous access guarantees privacy of users, traceability of users due to abuse of the service is not possible.)
Strategy	- Toughen user's functional components - Authenticate subjects - Define and enforce access policies - Secure communication infrastructures - Secure interfaces with external systems and services - Secure databases - Check data integrity for critical services - User digital certificates and encryption where necessary - Secure monetary transactions - Secure user's personal information

3.1.5 Privacy Requirements

Rationale: Ability of the system to ensure that the collection and transmission of personal data is minimized and handled in accordance with user's expectation and regulations.

Drivers: Protect the vulnerability aspects volunteered citizen's data

Requirements: NFREQ.18, NFREQ.19, NFREQ.20, NFREQ.21, NFREQ.22

Relevance: Ensuring users privacy is protected positively influences user's experience, acceptance and continuous use of the platform. Besides other factors, the reputation of the platform depends on how well user's information is secure and preserved.

PRIVACY MEASURES	
Actions	- Capture trust requirements - Perform risk analysis so measures can be implemented - Explore the vulnerability aspects of city data - Check whether extensibility requirements impact on trust - Define a trust model
Strategy	- Allow users to interact with the platform anonymously in given circumstances - Manage users identification securely - Anonymize data whenever necessary to comply with data regulations - Cryptograph personal identifiers during data transmission when that is necessary - Avoid unauthorized access to implicit information (e.g. location)

	Verify the impact of security, trust and scalability requirements trade-offs on privacy Allow the user to control how personal information is used Empower user to control the data disclosure mechanism
--	--

3.2 Non Run-time Quality Requirements

3.2.1 Evolvability Requirements

Rationale: The ability of the platform to withstand and easily adapt when new requirements and changes is introduced.

Drivers: Ensure the platform is able to accommodate additional functionality and emerging technologies at later stage at a fair and transparent cost

Refines into requirements: NFREQ.23

Relevance: Important for longer- lived and more widely used systems. Urban platforms are expected to be highly evolvable in order to accommodate future emerging technologies and avoid interoperability issues.

EVOLVABILITY MEASURES	
Actions	Characterize and assess the evolution needs Consider the evolution trade-offs Balance and negotiate potential conflicting requirements emerging from the evolution capability.
Strategy	Adopt standards and open interfaces Design loose-coupled components Preserve the platform resilience

3.2.2 Extensibility Requirements

Rationale: The flexibility of the system to allow services and functionality to be extended and augmented by service providers in order to increase value of services to both platform providers and end-users. The extension of the platform services is determined by the Platform Openness strategy.

Drivers: Stakeholders can extend the services provided by the urban platform, so that partnerships can be built to deliver holistic and interoperable solutions. Identify integrated approaches to design and service delivery which ensures that services fit together and that synergies can be exploited.

Refines into requirements: NFREQ.24, NFREQ.25

Relevance: Important for longer- lived and more widely used systems. Urban platforms are expected to be highly evolvable in order to accommodate future emerging technologies and avoid interoperability issues.

EXTENSIBILITY	
Actions	Characterize and assess the extensibility needs Trace the impacts and cost of extensions Negotiate potential conflicting requirements emerging from adding extensions in the platform
Strategy	Develop a modular architecture with standard interfaces that reduces entry barriers due to increased transparency and integration Share technical information about interfaces will help service providers in targeting opportunities around the platform

3.3 List of Non-Functional Requirements

ID #	Description	Concern	Priority	Domain
NFREQ.1	Support different service level agreements (SLA)	Scalability	Should	Platform, Infrastructure
NFREQ.2	Process services and events on a set of distributed nodes	Scalability	Should	Platform, Infrastructure
NFREQ.3	Continuously monitor Quality of Service at runtime	Scalability	Should	Platform, Infrastructure
NFREQ.4	Balance its load at runtime	Scalability	Should	Platform, Infrastructure
NFREQ.5	Provide high availability	Availability	Should	Platform, Infrastructure
NFREQ.6	Guarantee infrastructure availability	Availability	Should	Platform, Infrastructure
NFREQ.7	Ensure network availability	Availability	Should	Platform, Infrastructure
NFREQ.8	Be able to perform self-healing	Availability	Should	Platform, Infrastructure
NFREQ.9	Expose data and services to authorized users	Security	Must	City Data, Platform
NFREQ.10	Ensure services are always accessible to entitled users	Security	Must	City Data, Platform
NFREQ.11	Ensure Data Freshness	Security	Must	Platform
NFREQ.12	Support access control mechanisms	Security	Must	Platform
NFREQ.13	Have security mechanisms to protect data transmission	Security	Should	Platform, Infrastructure
NFREQ.14	Make it difficult to spy on communicated messages	Security	Should	Platform, Infrastructure
NFREQ.15	Be able to perform to detect threats at runtime	Security	Should	Platform, Infrastructure
NFREQ.16	Provide trusted and secure communication and information management	Trust	Should	Platform, Infrastructure
NFREQ.17	The platform infrastructure and services shall be trustable	Trust	Should	Infrastructure
NFREQ.18	Allow users to use free services anonymously	Privacy	Should	Societal Needs, Platform
NFREQ.19	Allow people to use free services anonymously	Privacy	Should	Societal Needs, Platform

NFREQ.20	Allow users to control which data they are willing to provide and how their data should be used	Privacy	Should	Societal Needs, Platform
NFREQ.21	Keep users access-control rights/ policies secured.	Privacy	Should	Platform
NFREQ.22	Provide privacy protection for users interacting with the platform	Privacy	Should	Societal Needs, Platform
NFREQ.23	Provide communication confidentiality	Privacy	Should	Platform, Infrastructure
NFREQ.24	Be extensible for future technologies.	Evolvability	Must	Societal Needs, City Data, Platform, Infrastructure
NFREQ.26	Provide standard interfaces for service providers	Extensibility	Should	Platform, Business Needs
NFREQ.26	Be able to provide services in an interoperable manner	Extensibility	Should	Platform

4. Other Requirements

4.1 Minimal Descriptive Metadata Required from Data Provider

Minimal Descriptive Metadata Required from Data Provider

Attribute	Required	Definition	Notes	Examples
Database Name	Y	A name given to the resource		
Author	Y	Name of a person or body associated with the creation of the resource		
Maintainer	Y	Name of the entity responsible for making the resource available		
Date Created	Y	Date the dataset was created		
Date Modified	Y	Date the dataset was modified		
Last Revision	Y	Date the dataset was last revised		
Update Frequency	Y	Frequency of data maintenance		
Mode of Release	Y	Open/Proprietary		

4.2 Urban Platform Supported Data Formats

MIME type	Description	Extensions	Level
application/json	JavaScript Object Notation	json	supported
application/xml	eXtensible markup language file	xml	supported
text/csv	Comma separated values file	csv	supported

5. Conclusion & Forward Plans

This document represents the first set of requirements specification for urban platform. Future activities will collaboratively assess, resolve requirements conflicts, prioritize, and validate the requirements of the urban platform. Ultimately, this document will become a complete final requirements specification document to guide and speed up the development open platform for cities. Table below shows the milestones, deliverables and engagement activities completed and yet to be completed by the Demand Side Engagement Stream.

Milestones, deliverables and engagement activity	Forecast date	Status
Stakeholders invitation	Late September/2015	Completed
Online Workshop 1: Project Scope and Outcomes <i>Online meeting held with city members to communicate goals, expected outcomes, time commitment and required actions.</i>	20/11/2015	Completed
Start of Collaborative Requirements Engineering Process <i>Participants reviewed the first draft of urban platform requirements, provided comments, and suggested new requirements and changes.</i>	20/11/2015	Completed
Online Workshop 2: Review and Refine Requirements <i>Participants had a conference call to review the requirements specification document and provide their comments.</i>	08/12/2015	Completed
Deliverable: Requirements Specification Document v2.1 shared across the Working Streams for consultation	05/01/2016	Completed
Online Workshop 3: Review Requirements Specification Document and discussion of Letter of Intent <i>Participants had a conference call to review the requirements specification document and provide their comments, and discussed the Letter of Intent to be signed by Mayor/Equiv of EU cities to commit to application of common U.P. approach.</i>	12/01/2016	Completed
Urban Platforms Workshop in Brussels <i>Participants provided feedback on the requirements specification document and recommended changes in the document</i>	19/01/2016	Completed

Deliverable: Updated Requirements Specification Document v2.2 shared with Industry and Standardisation Working Streams	29/01/2016	Completed
Deliverable: Online release of the Requirements Specification Document and open calls for wider consultation on the Requirements	Early February/2016	
Online Workshop 4: Engagement with Industry Side <i>Capture industry feedback on the Requirements Specification Document to assess its suitability to drive the development of the first draft reference architecture.</i>	Early February/2016	
Online Workshop 5: Review Requirements Specification Document v2.2 and discuss requirement prioritization and balancing <i>Collectively determine which candidate requirements of urban platforms should be prioritized as high importance to all the cities (use of Value Oriented Prioritization Method). Requirements are also prioritized to minimize risk during development of urban platforms so that the most important requirements are made explicit and considered in the reference architecture.</i>	Mid February/2016	
<i>Capture of case studies from cities intended to support requirements validation (City of Porto), and learning and confidence building amongst cities.</i>	Mid March/2016	