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Deliverable 2.1

Setting up OUP hubs for use case deployment in pilot sites

WP 2 – Set-up Phase

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Abbreviations

Abbreviation	Definition	Abbreviation	Definition
BIM	Building Information Modelling	CRS	Coordinate Reference System
DT	Digital Twin	IAM	Identity and Access Management
IFC	Industry Foundation Classes	MIM	Minimal Interoperability Mechanism
OGC	Open Geospatial Consortium	OUP	Open Urban Platform
REST	Representational State Transfer	WFS	Web Feature Service
WMS	Web Map Service	WP	Work Package

Table of contents

1 Introduction 5
2 Connecting stakeholders: user accounts and roles 6
2.1 Hub creation and ownership 6
2.2 User accounts and identity management 8
2.3 Role definition and permission model 8
2.4 Governance framework: data, applications, and users 9
3 Connecting selected (general) data sources to OUP Hubs 10
3.1 Dataset and resource registration 10
3.2 Validation of correct views in the OUP Viewer 10
3.3 Checks and determination of access and processing requirements 11
3.4 Data licensing and usage conditions 12
4 Connecting contextual data sources to OUP Hubs 13
4.1 Requirements checking and viewer validation 13
4.2 Uploading BIM models of 'to-be-built' buildings 13
4.3 Buildings to be removed 13
4.4 Semantic integration 13
5 Connecting Unreal Engine applications 15
5.1 Application registration and documentation 15
5.2 Authentication and authorization integration 15
5.3 Data visualization and validation 15
5.4 Calculation and simulation applications 15
6 Conclusion 17

Executive Summary

This deliverable documents the technical approach and implementation steps for setting up Open Urban Platform (OUP) Hubs to support use-case deployment in pilot sites. The focus is on establishing a robust, interoperable, and scalable hub configuration that enables stakeholders to collaborate, connect heterogeneous data sources, integrate BIM-based future developments, and visualize the combined datasets in advanced visualization environments such as Unreal Engine.

The setup follows the core OUP principles: separation of data storage and data usage, keeping data at its authoritative source, and exposing data via open, streaming web services. The result is a hub-based configuration that supports governance, access control, and reuse while minimizing vendor lock-in and duplication.

In addition to data integration, this deliverable addresses the governance and integration of calculation and simulation applications within the OUP ecosystem. It outlines how data licensing terms, application licensing and usage conditions, and role-based user access are aligned and enforced at hub level. Semantic integration enables heterogeneous data services to be translated into a common information model, allowing analytics and simulation platforms to consume harmonised inputs in a controlled and reliable manner.

1 Introduction

Deliverable D2.1 documents the technical and organisational setup of Open Urban Platform (OUP) Hubs to enable use-case deployment in the DT-aCoGo pilot sites. It is produced within Work Package 2 (Set-up Phase) and focuses on the practical establishment of hubs as the foundational layer for data sharing, application integration, and advanced digital-twin visualisation.

The OUP-hub is positioned as the central coordination and access layer for each pilot site. It brings together stakeholder management, identity and access control, federated service catalogues, and standardized data interfaces. Through this role, the OUP-hub ensures that all participating actors, such as public authorities, data providers, model operators, and viewers interact within a shared and trusted operational environment.

The scope of this document covers the stakeholder onboarding, including the definition of roles and responsibilities, as well as the connection and integration of both general and contextual data sources into a unified data environment. It further addresses the integration of BIM-based future developments to support the representation and assessment of planned scenarios, alongside the validation of data visualization within OUP Viewers to ensure accuracy, consistency, and usability. In addition, the scope includes the connection of Unreal Engine-based applications, enabling advanced, interactive, and high-fidelity visualization and simulation capabilities within the overall ecosystem.

Beyond data connectivity and visualisation, this deliverable covers the integration and governance of calculation and simulation applications operating on hub-connected data. It addresses the alignment of data licences, application usage conditions, and user access rights within the OUP governance framework, as well as semantic integration to ensure consistent cross-domain use of data as input for analytics and simulation workflows.

2 Connecting stakeholders: user accounts and roles

2.1 Hub creation and ownership

A single main Hub is established as the project's central Hub and shared data space. For
For each pilot site, a dedicated Sub-Hub is created to act as the primary organisational unit. Each Sub-Hub defines a clear digital boundary within which data, applications, users, and access rights are managed and governed.

Each Sub-Hub is owned by the pilot-site lead organisation, typically a municipality or coordinating authority, which is responsible for governance, compliance with Open Urban Platform principles, and long-term operation and maintenance.

Hub ownership entails accountability for the correct application of Open Urban Platform principles, the definition and enforcement of data-sharing policies, and the registration, monitoring, and lifecycle management of datasets and applications. It also includes responsibility for managing authentication and access-control mechanisms, ensuring that platform usage remains secure, compliant, and well governed.

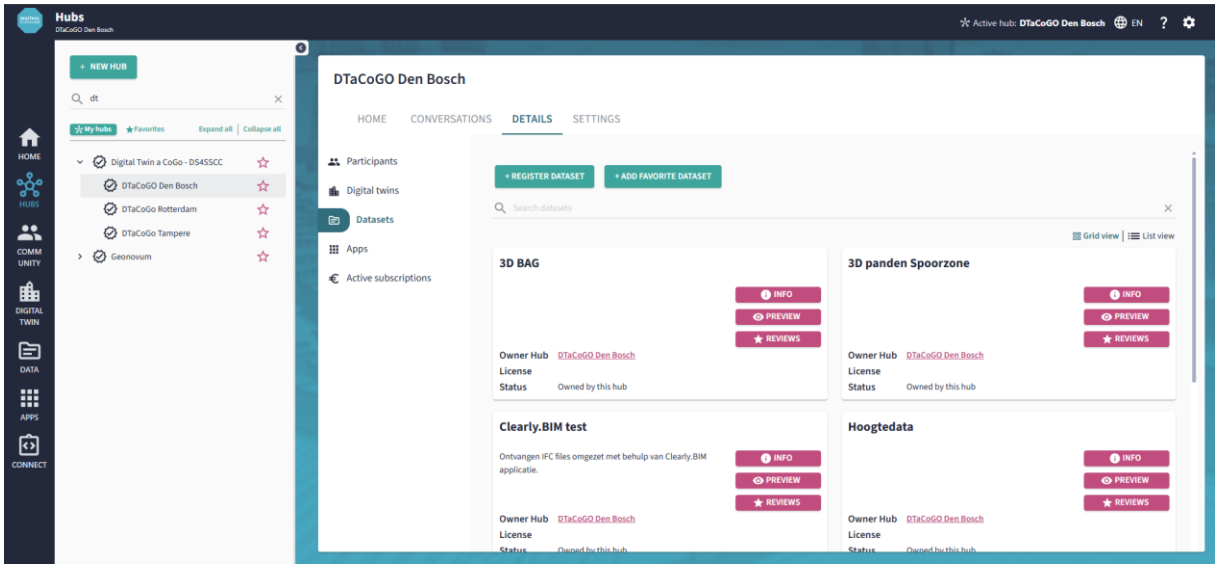


Figure 1 DT-aCoGo Den Bosch Sub-Hub

Nested Hubs may be created where necessary to reflect internal organisational structures, such as departments or project teams, while inheriting governance rules from the parent Hub.

Within the DT-aCoGo ecosystem, a federated hub architecture is implemented consisting of a single main project Hub and multiple Sub-Hubs representing both municipalities and project-specific environments for application providers. The main Hub acts as the central coordination layer, while three primary Sub-Hubs are established for the pilot municipalities (Rotterdam, 's-Hertogenbosch, and Tampere) each serving as the authoritative environment for managing local datasets, access rights, and governance policies.

Participating companies, including Purple Polar Bear (PPB), Tygron, Nelen & Schuurmans, Goudappel, and The People Group, each operate their own independent hubs outside the DT-aCoGo project environment. These external hubs are used for the development, execution, and management of their respective data processing pipelines, simulation models, and services.

For participation in the DT-aCoGo project, a dedicated Sub-Hub is assigned to each company within the project Hub. These project-specific Sub-Hubs act as controlled integration points where selected datasets and model outputs are prepared for sharing within the project ecosystem. This approach enables companies to maintain full control over their internal environments while exposing only relevant results to the shared platform.

Interaction between hubs follows a structured data-sharing workflow. Data and model outputs are generated within the company's own environment and made available through the corresponding project Sub-Hub. From there, relevant outputs are shared with the appropriate municipal Sub-Hub, depending on the geographic scope of the use case. For example, simulation results produced by Tygron for Rotterdam are shared from the Tygron project Sub-Hub to the Rotterdam Sub-Hub, where they become available for visualisation, analysis, and decision-making by municipal stakeholders.

This hub interaction model ensures a clear separation between internal company environments and the shared project ecosystem, while enabling controlled and traceable data exchange. By combining independent company hubs with project-specific Sub-Hubs and municipal Sub-Hubs, the architecture supports data sovereignty, secure collaboration, and scalable integration across organisational boundaries, in line with the principles of the Open Urban Platform.

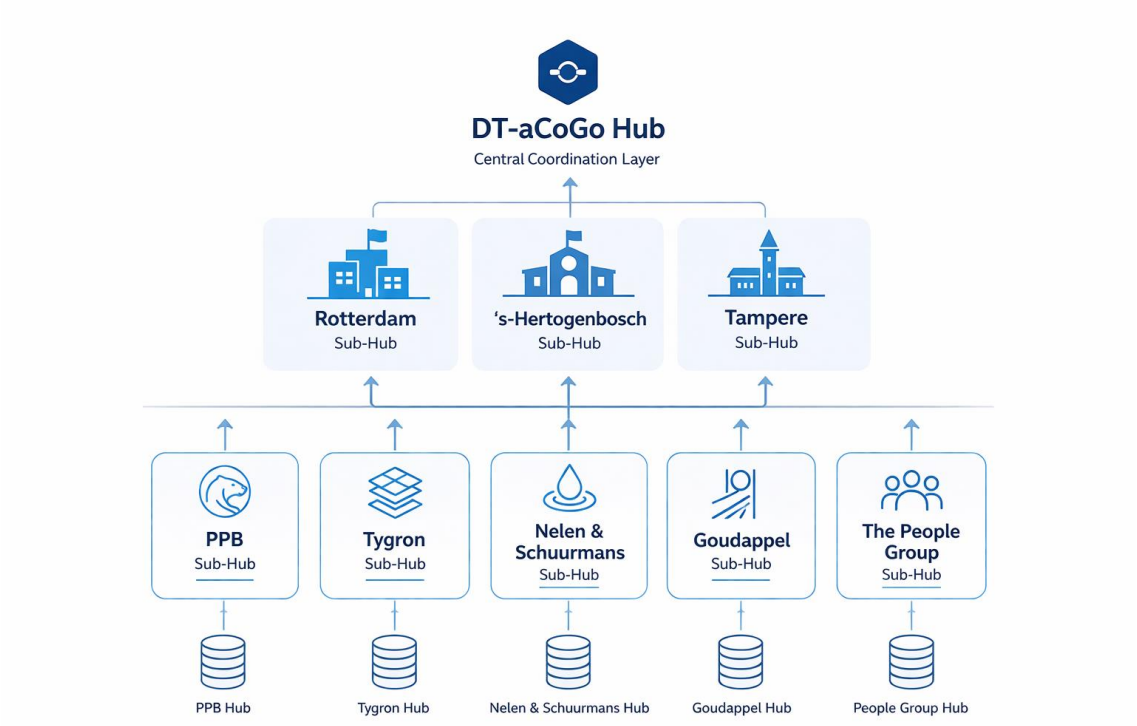


Figure 2 Federated Hubs Architecture of the DT-aCoGo Ecosystem

2.2 User accounts and identity management

All stakeholders participating in the pilot are onboarded as users within OUP. Identity management is handled centrally via the IAM component, ensuring a single, consistent identity across all connected applications and services.

User authentication follows OpenID Connect / OAuth 2.0 standards and supports both public access (for public hubs and datasets) and authenticated access (for protected or restricted resources). This setup ensures interoperability with external applications, including web-based dashboards and Unreal Engine-based viewers.

2.3 Role definition and permission model

Roles within the Open Urban Platform are assigned at Hub level and determine which actions users and organisations can perform within the platform. The role-based permission model enforces a clear separation of responsibilities and supports secure, transparent, and trustworthy collaboration across the ecosystem.

The permission model distinguishes between governance and oversight roles, platform operation roles, Hub-level management roles, and user roles. Together, these roles ensure compliance with the Open Urban Platform values framework, applicable legislation and regulations, and agreed policies on data sharing, security, privacy, and ethics.

Governance and oversight roles
Governance and ethical oversight of the platform are ensured through three distinct roles. The Governance Board acts as the platform regulator and ethical authority. It safeguards the values framework, determines rules of conduct, oversees compliance, and makes binding decisions on ethical, strategic, and policy-related matters.

The Market Master fulfils an independent supervisory and enforcement role. It monitors compliance with the values framework, agreements, and platform conditions, prepares reports and change proposals, and escalates issues to the Governance Board where necessary. The Market Master also has the authority to intervene in cases of non-compliance, including the removal of users, datasets, or applications.

The admin operates at Hub level on behalf of the Hub customer and ensures that rights, permissions, and activities within a Hub are correctly assigned and compliant with platform rules. The admin is the primary point of contact for the Market Master and is responsible for operational governance within the Hub.

Platform operation role
The Operator, fulfilled by Future Insight, is responsible for the development, operation, and technical maintenance of the Open Urban Platform. The Operator provides the platform services in accordance with the Service Level Agreement and operates under the oversight of the Governance Board and the Market Master. User support and platform development tasks fall under this role.

Hub-level management roles

At Hub level, ownership and operational responsibilities are clearly separated. The Hub Owner holds ultimate responsibility for the Hub, including its configuration, alignment with the values framework, and long-term maintenance. Hub ownership implies accountability for the correct application of platform principles, enforcement of data-sharing policies, and lifecycle management of datasets, resources, and applications.

The Hub Admin is responsible for the day-to-day operational management within the Hub. This includes user onboarding, permission management, creation of sub-hubs where applicable, purchasing and managing datasets and applications, and maintaining a compliant Hub environment. The Hub Admin does not have the authority to transfer Hub ownership.

User roles
Users join a Hub to share and or consume data and digital services within a governed ecosystem. A User is an individual or organisation that operates under agreed rules for access, usage, trust, and data sovereignty, without managing or operating the platform itself.

Different user types are recognised, including Passerby, Registered User, Paid User, Data Provider, and Application Provider. These roles determine access to platform functionalities and relevant governance documents, such as the values framework, terms and conditions, security statement, privacy protocol, service level agreement, and connection requirements.

Users interact with other ecosystem members through the platform's mechanisms for identity management, authorisation, and compliance, and may act as data providers, consumers, or both.

Accountability and traceability
This structured role and permission model ensures traceability of actions, clear accountability, and well-defined escalation paths between Admin, Market Master, and Governance Board. It provides a robust foundation for trust, transparency, and effective governance across the pilot ecosystem.

2.4 Governance framework: data, applications, and users

Beyond identity and role management, OUP provides the governance framework that regulates the interaction between data owners, application providers, and end users within the pilot ecosystem. This framework ensures that data sharing and application usage take place in a controlled, transparent, and compliant manner, aligned with the principles of data sovereignty and trust.

Within this framework, data owners remain responsible for defining the legal and organisational conditions under which their data is shared, including licensing terms and permitted usage. Application providers, in turn, define the conditions under which their applications can be accessed and used, such as licensing models, end-user licence agreements (EULA), and, where applicable, commercial terms. The OUP Hub acts as the enforcement layer, ensuring that these conditions are respected through access control, authentication, and service access.

Hub users are assigned roles that determine not only their technical permissions but also the scope of data and applications they are entitled to access. By centrally managing these relationships, the Hub enables a balanced governance model in which data providers, application developers, and users can collaborate within a shared ecosystem while retaining clear responsibilities and legal boundaries.

3 Connecting selected (general) data sources to OUP Hubs

General data sources represent baseline information describing the existing urban environment. These datasets form the common reference layer for all pilot use cases and applications.

3.1 Dataset and resource registration

Each general data source is registered as a dataset in the Data Catalog of the corresponding Hub. The dataset contains rich metadata describing content, scope, spatial coverage, and ownership. One or more resources are then registered to link the dataset to the actual streaming services provided by the data owner.

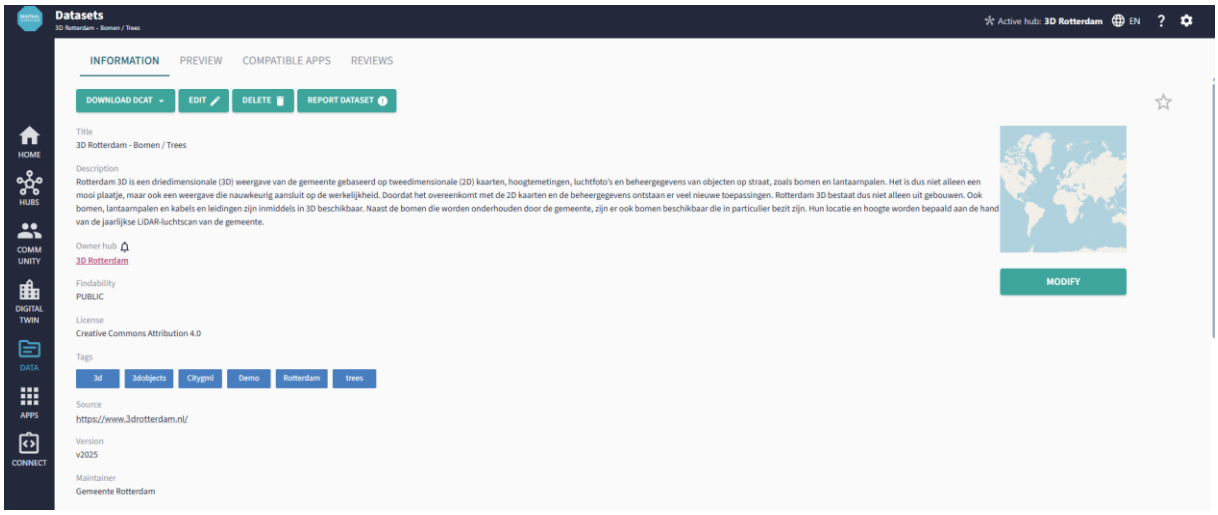


Figure 3 Example of 3D Rotterdam - Bomen / Trees Dataset

This approach ensures a clear separation between metadata (dataset) and data access (resources), fully aligned with OUP architecture principles.

3.2 Validation of correct views in the OUP Viewer

After registration, each resource is validated using the OUP Viewer. The validation process includes checks on correct spatial reference and georeferencing, visual alignment with other baseline datasets, proper layer loading, styling, and level-of-detail behaviour, as well as acceptable performance under typical usage scenarios to ensure reliable and consistent visualization.



Figure 4 Example of checking a 3D resource alignment with other base layers in OUP digital twins' viewer

Only datasets that pass these validation checks are approved for use in pilot applications.

3.3 Checks and determination of access and processing requirements

For each selected general data source, a structured technical assessment is performed to determine access conditions, interoperability requirements, and suitability for integration within the Open Urban Platform. This assessment ensures that datasets can be reliably accessed, combined, and reused across applications while meeting performance and governance requirements.

From a standards perspective, the platform primarily relies on Open Geospatial Consortium (OGC) interfaces, including Web Map Service (WMS) and Web Feature Service (WFS) for geospatial data access, and 3D Tiles for efficient streaming and visualisation of large-scale 3D datasets. In addition, BIM data is handled using the Industry Foundation Classes (IFC) standard, which is processed through a validation and transformation pipeline before being exposed as 3D Tiles services for use in the Digital Twin environment.

Category	Standards
Identity & Access Management	SAML (Security Assertion Markup Language), OpenID
Catalog Metadata	DCAT
2D Geographic Streaming Data	OGC WMS, WMTS, WFS; OGC API Features; TMS (Tile Map Services); XYZ Tile Format; TileJSON; GeoJSON
3D Geographic Streaming Data	3D Tiles; 3D Terrain
BIM Data	IFC; 3D Tiles
Sensor Data	SensorThings API

Table 1 Overview of Open Standards Supported by Clearly.Hub Across Data Domains

Data access and service interaction are implemented through web-based APIs, including RESTful interfaces and GraphQL endpoints provided by the Open Urban Platform. These APIs enable applications, including Unreal Engine-based viewers and external model providers, to retrieve and interact with data in a consistent and controlled manner.

Authentication and authorisation are managed through OAuth 2.0 and OpenID Connect protocols, implemented via AWS Cognito as the identity provider. Secure access to protected data services is enforced through the OUP proxy layer, which acts as an intermediary between users and data providers. The proxy manages credentials, injects required authentication tokens, and ensures that sensitive information (such as API keys) is not exposed to end users. This mechanism enables secure integration of both open and restricted data sources within a unified environment.

Finally, technical considerations such as coordinate reference systems (CRS), data formats, and service performance are evaluated during this step to ensure correct spatial alignment, compatibility between datasets, and reliable operation within the platform. Together, these standards, specifications, and technologies provide a robust foundation for interoperable and secure data integration within the DT-aCoGo ecosystem.

3.4 Data licensing and usage conditions

For each dataset registered within an OUP Hub, licensing and usage conditions are defined and documented as part of the dataset metadata. Datasets may be classified under different licensing regimes, such as open data, restricted partner data, or data subject to commercial agreements. This information is made transparent to all authorised users and applications through the Data Catalog.

Enforcement of data licences and usage conditions is achieved through the Hub's identity and access management mechanisms. Access to protected datasets is granted only to authenticated users and applications with appropriate roles and permissions, ensuring that data is consumed in accordance with the defined terms. This approach enables controlled data sharing across organisational boundaries while preserving the authority and rights of data owners.

4 Connecting contextual data sources to OUP Hubs

Contextual data sources provide additional, use-case-specific information that extends the baseline datasets. These sources typically reflect planned developments, temporary situations, or thematic layers relevant to the pilot scenarios.

4.1 Requirements checking and viewer validation

Each contextual data source undergoes the same technical and visual validation checks as general data sources, with additional attention given to consistency with baseline datasets to avoid spatial offsets or conflicts, correct representation when combined with other contextual layers, and a clear distinction between current-state and future-state information to ensure accurate interpretation.

Validation is performed in the OUP Viewer to ensure that all contextual data is displayed correctly and behaves as expected.

4.2 Uploading BIM models of 'to-be-built' buildings

BIM models representing planned or "to-be-built" buildings follow a dedicated workflow in which IFC models are first uploaded in the BIM repository, serving as the control environment for BIM data. The models' integrity and georeferencing are then verified and corrected where necessary, after which 3D Tiles are generated based on the validated BIM models to enable efficient streaming and visualization. Finally, the resulting 3D Tiles services are registered as resources within the appropriate OUP Hub dataset.

This workflow ensures that BIM data remains managed at its authoritative source while being consumable through open standards within the OUP ecosystem.

4.3 Buildings to be removed

Buildings or structures planned for removal are explicitly identified during data preparation and published as contextual resources. This enables applications to exclude these objects from future-state scenarios and to clearly distinguish between existing, future, and removed elements within combined visualizations and analyses.

This approach avoids ambiguity in visualization and analysis and supports consistent scenario-based representations.

4.4 Semantic integration

To enable meaningful cross-domain analysis and consistent use of heterogeneous data sources, semantic integration is applied as a core step in the contextual data connection workflow. This ensures that datasets originating from different providers, systems, and domains can be interpreted uniformly by downstream applications and analytical models. Given the diversity of data sources across the pilot cities, semantic integration is essential to guarantee that data can be reliably combined, compared, and reused within the Digital Twin ecosystem.

Within the DT-aCoGo pilots, semantic integration is implemented through the Purple Polar Bear (PPB) application, which acts as an intermediate data harmonisation and transformation layer. Datasets from municipalities such as Rotterdam, 's-Hertogenbosch, and Tampere are provided through various services (e.g. WMS, WFS, 3D Tiles, and BIM/IFC), and typically differ in structure, schema, and semantics. PPB ingests these heterogeneous datasets and processes them to ensure that they can be consistently interpreted across the platform.

The harmonisation process consists of multiple steps, including schema mapping, semantic alignment, and transformation into a common generic data model. At the structural level, PPB aligns dataset schemas by mapping attributes, normalising geometries, and resolving differences in data organisation. At the semantic level, it reconciles differences in classification systems and domain meanings to ensure that urban objects such as buildings, infrastructure, and environmental features are interpreted consistently across cities. The harmonised datasets are then transformed into a shared data model that serves as a standard interface for analytical models and applications.

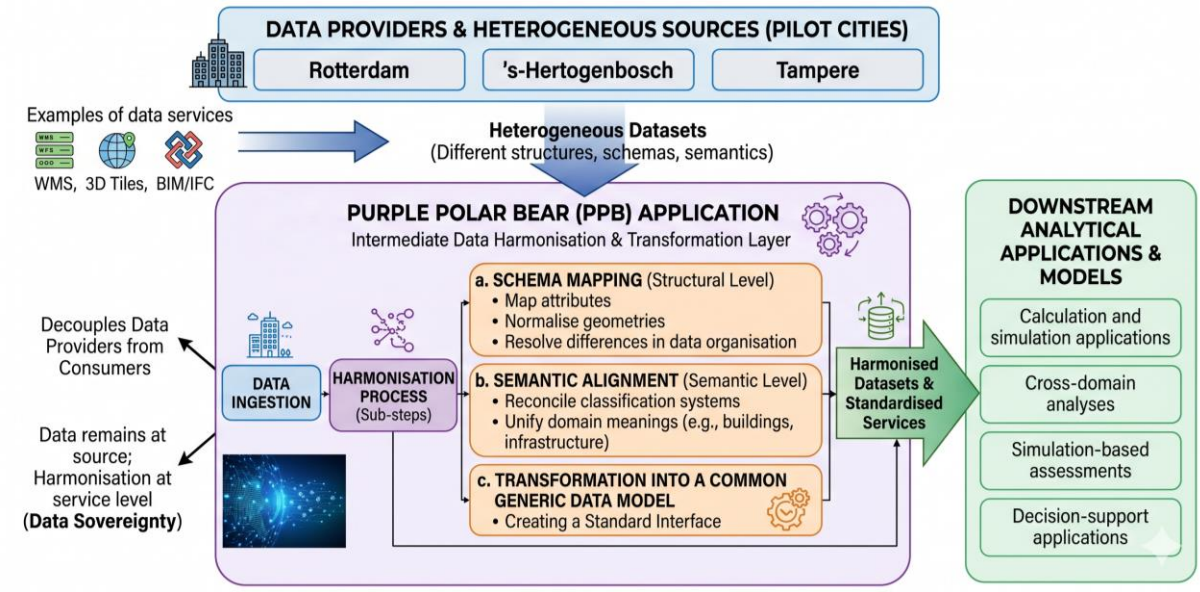


Figure 5 Semantic Integration and Data Harmonisation Workflow in the DT-aCoGo Ecosystem

This harmonised data is subsequently consumed by calculation and simulation applications, which rely on consistent and model-ready inputs to perform cross-domain analyses. By introducing this transformation layer, PPB decouples data providers from data consumers, allowing analytical models to be applied across different cities without requiring custom integrations. At the same time, the original data remains at its authoritative source, and the harmonisation is applied at the service level in accordance with OUP principles of data sovereignty and separation of data storage and data usage.

By providing semantically aligned and standardised data services, semantic integration enables advanced analytical workflows, simulation-based assessments, and decision-support applications within the DT-aCoGo ecosystem. It forms a critical bridge between raw data provision and higher-level analytics, ensuring that data from multiple domains and cities can be used as a coherent and reliable input for Digital Twin applications.

5 Connecting Unreal Engine applications

Unreal Engine-based applications are used to provide advanced 3D visualization and interaction capabilities for pilot use cases.

5.1 Application registration and documentation

Each Unreal Engine application is registered in the App Catalog of the relevant OUP Hub. Where applicable, associated API documentation is registered as a dataset with api_documentation resources and linked to the app. This ensures transparency, reuse, and consistent onboarding of new developers.

5.2 Authentication and authorization integration

Applications integrate with the IAM component using OAuth 2.0 (Authorization Code Grant with PKCE) to enable secure user authentication, user-aware access to protected datasets, and enforcement of hub-based permissions within the Unreal application. Access tokens obtained via the IAM are subsequently used to authenticate API requests to the OUP Core API, ensuring secure and authorised interaction with platform services.

5.3 Data visualization and validation

All connected datasets, both general and contextual, are validated within the Unreal Engine environment to ensure correct loading of 2D and 3D streaming services, accurate georeferencing and alignment across datasets, and proper handling of future-state and removed-building scenarios.

Successful validation confirms that the Unreal Engine application consumes OUP data correctly and consistently, without data duplication or platform-specific dependencies.

5.4 Calculation and simulation applications

In addition to data integration and visualisation, the Open Urban Platform supports the integration of calculation and simulation applications that operate on semantically harmonised data services. These applications form a key component of the DT-aCoGo ecosystem, enabling the generation of derived insights, indicators, and scenario-based analyses to support urban planning and decision-making processes. By consuming standardised data provided through the hub environment, these applications can operate consistently across different domains and pilot cities.

Within the DT-aCoGo pilots, three primary calculation and simulation applications are integrated: (i) a pluvial flooding model (Nelen & Schuurmans), (ii) a heat stress model (Tygron), and (iii) a mobility and traffic model (Goudappel). These applications are implemented consistently across all pilot cities (Rotterdam, 's-Hertogenbosch, and Tampere) enabled by the harmonised data layer described in Section 4.4. Input datasets are accessed through the Open Urban Platform and standardised via the data processing and translation pipeline, ensuring that identical model logic can be applied across different urban contexts without the need for city-specific adaptations.

The pluvial flooding model simulates surface water accumulation and flood dynamics under heavy rainfall conditions. It consumes geospatial datasets such as terrain elevation models, 3D city models, land use data, and drainage-related information where available, typically accessed via WMS and 3D Tiles services. The model generates outputs including flood extent maps, water depth layers, and temporal flood behaviour indicators. These outputs are published back to the platform as geospatial services and visualised within the Digital Twin environment, supporting climate adaptation strategies and risk assessment workflows.

The heat stress model assesses urban climate conditions by analysing the interaction between built environment characteristics and meteorological inputs. It consumes datasets such as building geometries (from 3D city models or BIM), surface materials, vegetation layers, and weather-related parameters. Based on these inputs, the model produces outputs including heat stress indicators, urban heat island intensity, and spatial temperature distributions. In parallel, the mobility and traffic model evaluates transport system performance and accessibility under different urban scenarios, including disruptions caused by flooding. It consumes road network data, infrastructure layers, and scenario-based inputs, and generates outputs such as traffic flow patterns, accessibility indicators, and network performance metrics. The results of all models are reintegrated into the platform and exposed as new datasets or services, enabling reuse by other applications and visualisation in Digital Twin environments.

Access to calculation and simulation applications is managed through the OUP governance framework, including identity and access management, role-based permissions, and licensing conditions. Applications are registered in the App Catalog with associated metadata, ownership, and usage constraints. Users can only access and execute models for which they are authorised, ensuring protection of intellectual property, organisational separation, and compliance with agreed data usage policies. Through this approach, calculation and simulation applications are seamlessly integrated into the OUP ecosystem as reusable, governed services that support cross-domain analysis and decision-making across all pilot cities.

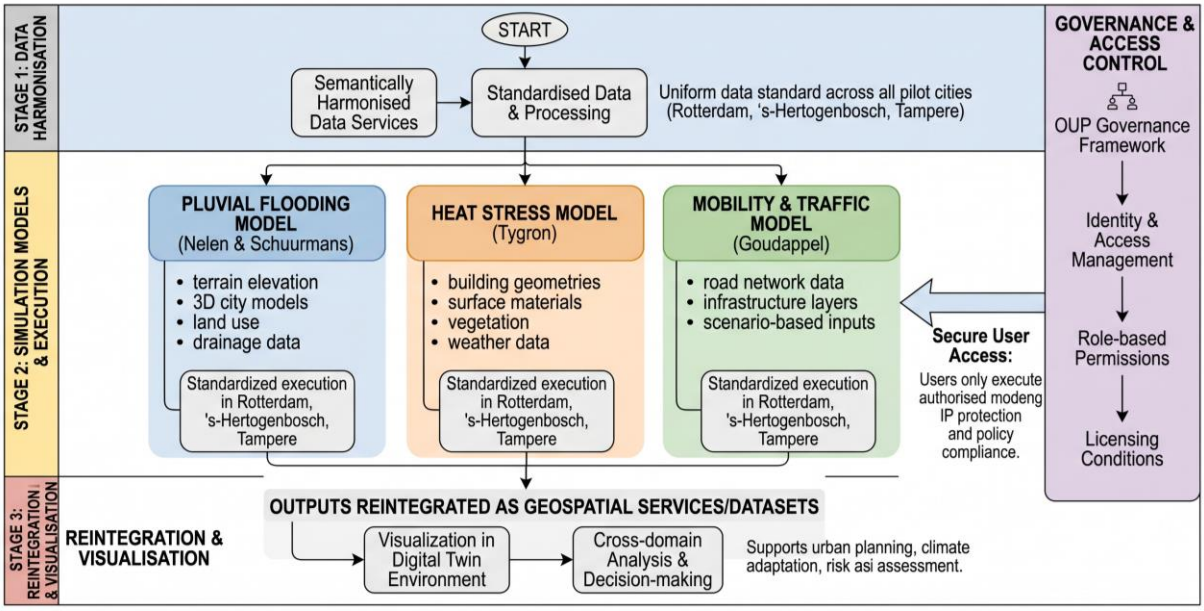


Figure 6 Workflow Integration of Calculation and Simulation Models within the Open Urban Platform (OUP)

5.5 Data Requirements and Implementation Status

Building on the calculation and simulation applications described in Section 5.4, the pilot framework supports flood resilience, mobility disruption, and urban heat stress assessment in Rotterdam, 's-Hertogenbosch, and Tampere. The matrices below summarise the common data requirements, the currently registered Rotterdam resource examples, and the high-level implementation status.

Data resource	Rotterdam	's-Hertogenbosch	Tampere	Flood resilience	Mobility disruption	Heat stress
Common Model hub/API connectors	✓	✓	✓	✓	✓	✓
2D building data	✓	✓	✓	✓		✓
3D building data and scenario tiles	✓	✓	✓	✓		✓
2D tree and vegetation data	✓	✓	✓			✓
3D tree and vegetation scenario tiles	✓	✓	✓			✓
Road segment / road network data	✓	✓	✓		✓	✓
Mobility indicators and key figures	✓	✓	✓		✓	
Meteorological / weather data	✓	✓	✓			✓
Terrain / elevation model	✓	✓	✓	✓		
Land use / surface data	✓	✓	✓	✓		✓
Flood model simulation results	✓	✓	✓	✓	✓	
Mobility model simulation results	✓	✓	✓		✓	
Heat model simulation results	✓	✓	✓			✓

Table 2 Mapping of pilot use cases and associated data requirements.

Component / use case	Registered Rotterdam resources	Role in the pilot workflow
Common-model access	Rotterdam - Connector page; Rotterdam Common Model via GetCapabilities.	Entry points for hub services, WFS/API access, and Common Model dataset discovery.
Heat stress	Rotterdam 2D Trees - Common Model; Rotterdam 2D Buildings - Common Model; Rotterdam 2D Road Segments - Common Model; Rotterdam KNMI Weather Data - Original; Tygron - Connector page.	Input layers and model connection for the Tygron heat stress workflow.
Flood resilience	Rana - Connector page; Rotterdam 2D Buildings - Common Model.	Flood model connection and built-environment input for pluvial flood assessment.
Mobility disruption	dat.Mobility - Connector page; Mobility Model Key Figures; Rotterdam Mobility Key Figures - Common Model.	Mobility model connection and indicators/results for disruption assessment.
Game-engine visualisation	Rotterdam 3D Trees and 3D Buildings for Current Situation, Merwehaven Scenario, Schiehaven Scenario, and Combined Scenario; The People Group - Connector page.	3D Tiles and scenario layers used for Digital Twin visualisation in the game-engine environment.

Table 3 Registered Rotterdam resource examples supporting the pilot use cases and visualisation workflow.

Table 4 provides a high-level overview of the current implementation status of the DT-aCoGo pilot environments. It summarises progress on hub configuration, data registration, model integration, and overall use-case readiness for Rotterdam, 's-Hertogenbosch, and Tampere.
In this context, model integration refers to the connection of simulation and analysis workflows to the Open Urban Platform environment. This includes linking registered datasets to the flood resilience, mobility disruption, and heat stress models, as well as preparing model outputs for publication, sharing, or visualisation through the platform.

Pilot City	Hub Configuration	Data Registration	Model Integration	Use Case Status
Rotterdam	Completed	Completed	Completed	In Progress
's-Hertogenbosch	Completed	Completed	Completed	In Progress
Tampere	Completed	Completed	Completed	In Progress

Table 4 High-level implementation status of DT-aCoGo pilot environments.

Figure 7 illustrates the practical use of the Open Urban Platform for accessing and validating pilot-specific model outputs. The example shows Rotterdam heat stress result layers for the Merwehaven area, including protected resources and map layers connected to the relevant pilot hub. This demonstrates how registered datasets and derived model results can be inspected in their spatial context and used to support further analysis and decision-making. As such, the figure complements the data requirements and implementation status tables by showing how hub configuration, data registration, model output publication, and visualisation come together in the preparation and validation of the heat stress use case in Rotterdam.



Figure 7 OUP preview of Rotterdam heat stress result layers for the Merwehaven area

6 Conclusion

This deliverable has described the structured setup of Open Urban Platform (OUP) Hubs as the foundational layer for use-case deployment across the DT-aCoGo pilot sites. By following a clearly defined technical and organisational approach, WP2 has established a common operational framework that enables stakeholders, data sources, and applications to interact within a trusted, interoperable, and scalable ecosystem.

The implemented hub configurations demonstrate how OUP principles are translated into practice: data remains at its authoritative source, access is governed through clear identity and role management, and datasets are exposed via open, standardised streaming interfaces. This approach ensures that data can be reused across multiple applications and scenarios without duplication, while preserving data sovereignty, traceability, and compliance with organisational and legal constraints.

A key outcome of this work is the successful integration of heterogeneous data types, including baseline geospatial datasets, contextual thematic layers, and BIM-based representations of future developments. The defined workflows for BIM data, from IFC validation and georeferencing to 3D Tiles generation and hub registration, provide a robust mechanism for incorporating planned and "to-be-built" assets into digital twin environments. Similarly, the explicit handling of buildings to be removed enables clear distinction between current-state and future-state scenarios, supporting consistent interpretation and analysis.

The connection of Unreal Engine applications further validates the role of OUP Hubs as a neutral integration layer between data providers and advanced visualisation environments. Through standardised authentication, authorisation, and API access, Unreal Engine applications can consume OUP-managed data securely and consistently, demonstrating that high-fidelity, interactive digital twin experiences can be achieved without introducing platform-specific dependencies or vendor lock-in.

Beyond the immediate pilot deployments, the outcomes of this deliverable provide a reusable blueprint for future hubs and use cases. The role model, dataset registration practices, validation procedures, and application integration patterns established in WP2 can be replicated across additional communities, domains, and projects within the broader European data space context. As such, this work lays a solid foundation for subsequent work packages, enabling WP3 and beyond to focus on use-case execution, cross-pilot comparison, and value creation rather than platform setup.

In conclusion, the setup of OUP Hubs as described in this deliverable successfully establishes the technical and organisational conditions required for reliable digital twin deployment in the DT-aCoGo pilots. It confirms the viability of the OUP approach as a scalable coordination layer for smart community data spaces and positions the platform as a key enabler for interoperable, future-proof urban digital twins aligned with European data space principles.

About the European Data Space for Smart Communities

The European Data Space for Smart Communities (DS4SSCC-DEP) initiative is a pivotal deployment following the preparatory action for a Data Space for Sustainable and Smart Cities and Communities (DS4SSCC). Emphasising sustainability aspects and diversity in communities, DS4SSCC developed a multi-stakeholder data governance scheme, created a blueprint for the European DS4SSCC, delivered priority datasets, and developed a roadmap towards a mature DS4SSCC.

DS4SSCC-DEP's vision revolves around creating a well-governed federated territorial, place-based data space for smart communities available for developers and infrastructure providers, aligning with the prospects outlined in Europe's Digital Decade objectives. This approach distinguishes itself from sectoral data spaces by encompassing diverse domains, and underpinning governance across all levels of society. The key objectives of the project are:

- **Objective 1: Establishing a Federated and Innovative Data Space**. This phase focuses on creating a large-scale data space controlled by public data holders, ensuring alignment with the Smart Middleware Platform and broader data space ecosystems. It also aims to offer middleware service solutions facilitating data sharing and management while refining the blueprint based on gained experience.
- **Objective 2: Pilots and Refinement of the Data Space Blueprint**. Through 10-12 cross-sectoral data pilots in various EU communities, this objective aims to validate and refine the data space blueprint. Using common high-value data sets, it seeks to create added value by combining data from various domains, contributing to the sustainability plan, and minimising infrastructure investment.
- **Objective 3: Fostering Innovation and Ecosystem Alignment**. Engaging stakeholders, compliance with sector-specific legislation, establishing links with Horizon Europe missions, creating services available via trusted application catalogues, and enhancing ethical considerations and AI-enabled local solutions constitute the focus of this objective.

DS4SSCC-DEP, building upon established European networks, aims to significantly contribute to the sustainability goals of European citizens. It emphasises co-creation, standardisation, business models, strategies for data spaces, and envisions a federated platform.

DS4SSCC-DEP consortium includes the following partners:

OPEN & AGILE SMART CITIES & COMMUNITIES		imec	FIWARE
IDC	serendipity	TAL TECH, FinEst Centre for Smart Cities	Gospodarska zbornica Slovenije, zit ICT Association of Slovenia