BUILDSPACE

Funded by the European Union

SLOVENIAN PILOT

Urban Flood Analysis and Resilience service in Ljubljana Urban Region, Slovenia

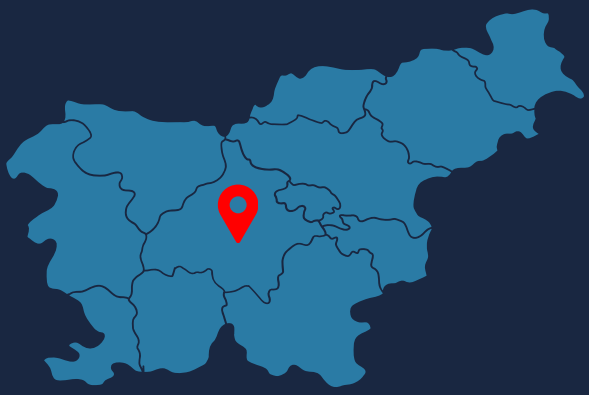
BUILDSPACE brought its innovative digital services into practice through four pilot sites across Europe. Each pilot addressed a different local challenge. The pilots demonstrate how BUILDSPACE solutions can support smarter construction, sustainable energy planning, and better protection of cities against heat and flooding.

CONTEXT & OBJECTIVES

Pilot Overview

Location: Ljubjana, Slovenia

Ljubljana, the capital of Slovenia, is located between two rivers: the **Ljubljanica** and the **Sava**. Due to its vulnerability to flooding, Ljubljana has a long history of implementing various flood protection measures, yet many parts of the city remain heavily threatened by floods.



Strategic Importance

The Ljubljana pilot served as a living laboratory for integrating climate resilience, digital innovation, and stakeholder participation. It not only strengthened Ljubljana's own flood preparedness but also provides a transferable model for other European cities seeking to adapt to climate change through data-driven, nature-based, and socially inclusive approaches.

Pilot Objectives

This pilot's main objective was to apply a data-driven, user-friendly approach to assessing expected flood damage to buildings and flood vulnerability hotspots with hydrological impacts of blue-green infrastructure (BGI), using advanced analysis and visualization tools. The service is operated by a user-friendly web tool with a colored map and different types of graphs as the basis for delivering the information in a very visual and easy-to-use way.

In this way, the service provides a decision support service to assist urban stakeholders in planning the maintenance and retrofitting of buildings against the risk of climate change. This service uses simplified models to better analyze the benefits or value of interventions and consider the effects of climate change. The pilot also included training and awareness-raising activities, such as training sessions and presentations for local stakeholders, to promote the use of the service, foster stakeholder engagement, and increase social acceptance of BUILDSPACE.

KEY STAKEHOLDERS

IMZI
Blue-green Infrastructure Institute

nazka

IMPLEMENTATION & LESSONS LEARNT

Phase 1: Preparation & Deployment plan

IMZI, acting as both the pilot implementer and service provider, led the formulation of the monitoring and evaluation framework, the preparation of the pilot, setup of the testbed scenario, execution of the designed use cases, and the evaluation process, ensuring the pilot's local relevance.
During the pre-pilot phase, IMZI worked closely with **NAZKA** (the designated technical partner), to identify and collect relevant data from local administrative databases, satellite imagery (Copernicus services), and sensor data. Together, they defined achievable service levels based on available resources and developed the data visualisation for Use Case 5.1 – Flood Damage Hotspots at the city level.

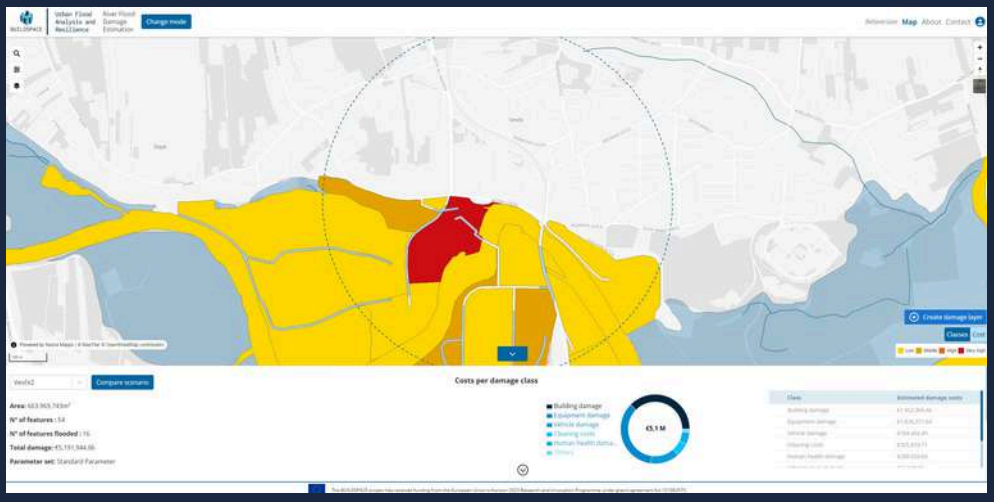
Phase 2: Implementation & Execution

During the full pilot phase, IMZI completed data collection for both use cases, including a special focus on:

- Urban Atlas Cover for service calculations and CORDEX projections, supporting climate-driven hydrology scenarios for BGI Impact analysis.
- Meteorological data from weather stations, forming the basis for local RCP scenarios.
- Fieldwork to verify the extent of urban green areas.

Following the collection of GIS data, model data was deployed to the tool, followed by Copernicus data (Urban Atlas Cover) via APIs. These datasets, combined with the model's outputs, supported the service's calculations, while satellite imagery was used for the background map.
Sensors' data deployment was omitted, as the subcontracted operator supplied pre-calibrated outputs for local RCP scenarios. Climate-driven hydrology scenarios were generated by analyzing historical and projected precipitation, covering RCP2.6, RCP4.5, and RCP8.5 IPCC scenarios for the pilot area.

Costs per building in the data panel and categorical visualisation on the map



Costs per land use class in the data panel and categorical visualisation on the map

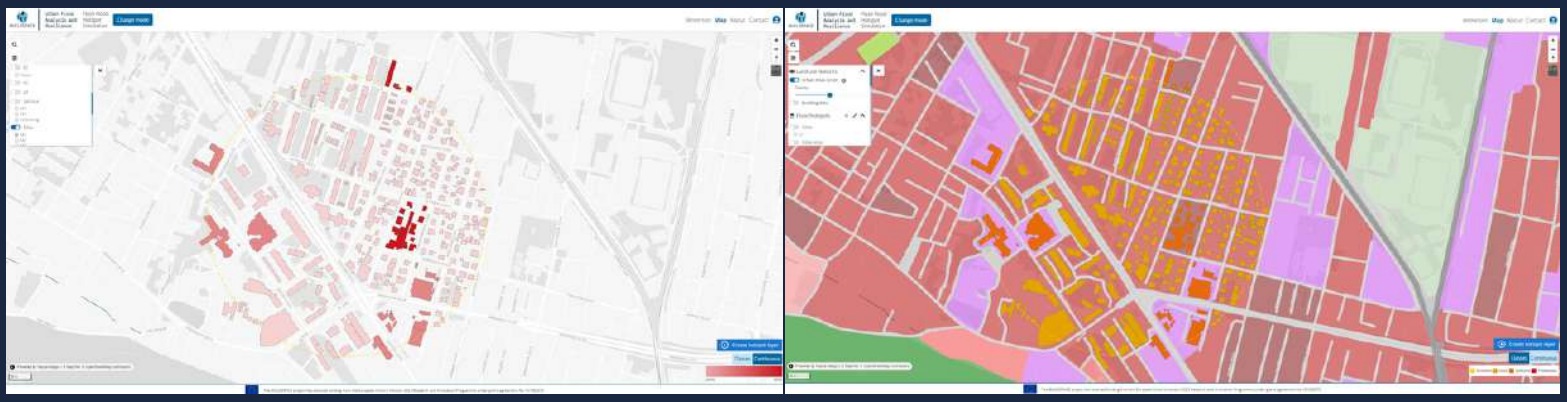
Meanwhile, as a pilot partner, IMZI contributed to the effort by raising awareness and training local stakeholders on resilience frameworks, risk assessment, and adaptive planning. IMZI fostered partnerships between city departments, NGOs, universities, and the private sector by participating in awareness-raising and training events.

The Ljubljana Urban Region played a critical role in supporting the implementation of the service. It acted as a testing ground, model, and learning hub. The pilot facilitated the implementation of the service by supporting the application of the tool in a real-world, urban, city-level context. As a pilot partner, IMZI monitored and evaluated the calculations to ensure they were intuitive and user-friendly, even for non-specialists.

Phase 3: Completion

In the last phase of the pilot, the service application received major updates:

- On-the-fly calculations with user input for all parameters, including flood extent, flood depth, and land use features.
- Integration with Urban Atlas Cover to increase replicability, enabling damage layer calculations for European urban areas with at least 50,000 inhabitants.
- New data panel for detailed analysis of damage layers.
- Enhanced map visualizations (categorical and continuous scales) and comparison mode with slider for easier scenario comparison.
- Addition of blue-green infrastructure (BGI) impact visualization.
- Testing and refinement of BGI impact and satellite data implementation; due to limitations in Copernicus high-resolution vegetation data, the focus shifted to using Urban Atlas data.



The pilot featured:
Live demonstration events for local stakeholders to understand and apply service outputs.
Online training sessions to engage stakeholders and discuss future applications.

The phase demonstrated the importance of early stakeholder engagement, clear communication, and adaptability, laying a strong foundation for integrating BUILDSPACE services into long-term urban resilience strategies.

Key Lessons & Recommendations

Digital Twin Generation

Before planning new drone operations, cities and project partners should first explore whether relevant datasets already exist and can be accessed through local authorities or open data sources. Leveraging existing resources can save both time and costs while streamlining project execution.

User training is essential: Even simple interfaces require guidance on interpreting outputs and knowing what actions to take.

Provide domain knowledge that helps validate or interpret the twin's insights in context. Deep sector-specific knowledge needed.

Cross-functional collaboration is required: Users from planning, operations, and IT need to work together.

Urban Flood Analysis and Resiliance

Basic data analytic skills needed to interpret graphs, tables and other data visualisation outputs.

User training is essential: Even simple interfaces require guidance on interpreting outputs and knowing what actions to take.

Cross-functional collaboration is not necessary, as the tool has been designed to be so user-friendly that it can be used by non-professionals.

Technical requirements for end-user to receive service

In order to use the URBAN FLOOD ANALISIS AND RESILIENCE application the only requirements are connection to internet and a browser.

Results, Performance & Future Outlook

The pilot achieved its objectives, showcasing the potential of city-scale services to promote informed decision-making and boost urban flood resilience. By identifying urban flood hotspots and visually assessing expected flood damage and urban runoff with BGI impact, the pilot shows the value of combining scientific data with local knowledge. The pilot also emphasizes the importance of clear communication, user-friendly interfaces, and sustained capacity building for long-term success.

A few words form IMZI

Our experience with the BUILDSPACE services has been **very positive**.

Through the implementation of Urban Flood Analysis and Resilience service, **we were able to apply a user-friendly tool to promote informed decision-making and boost urban flood resilience**. The integration of these technologies has helped us better understand the issues of local urban flood resilience and the hydrological impact of blue-green infrastructure (BGI).

The results have shown urban flood hotspots and visually assessing expected flood damage and urban runoff with BGI impact, and one of the most surprising findings was that the tool attracted interest from a wide range of stakeholders, including non-professionals, who were also likely to recommend the service to others. **These insights will inform the future development of our territory by enhancing data-driven decision-making and urban flood resilience strategies, and contributing to the development of future services**. Information on flood hotspots, potential damage and the impact of blue-green infrastructure on the hydrological cycle will be used to refine analytical models and planning tools. Strong stakeholder engagement, including interest from non-professionals, demonstrates the tool's accessibility and potential for wider adoption. These outcomes will be sustained through continued collaboration with stakeholders, enhancement of the tool, and its integration into future urban flood resilience services.

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