FinEst Centre
for Smart Cities

SMART CITY CHALLENGE 2025
Solution idea for the city challenges

Solution Idea Title: Flood-Resilient Integrated City Governance

Planned pilot project duration: 24 months.

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1. Which urban challenge or problem are you planning to provide a solution to?

Main Target Challenge: Safe and Climate Resilient Cities - Safety in case of natural or human disasters (e.g., Castenaso, Porto-Alegre).

Natural hazards, such as storms, riverine and pluvial floods, can cause major impacts, including loss of life, displacement, and damage to property, strategic buildings, and economic activities. They also threaten vital infrastructures (e.g., transport, water, energy, and communication networks) causing exponential direct and indirect losses and prolonging recovery. Leveraging these interdependencies, the proposed solution can deliver benefits that extend beyond flood risk, supporting cities in addressing a broader range of challenges, such as: i) *Intelligent Management of Sewer and Stormwater Networks* (e.g. Tallin, Istanbul); ii) *Multiple City Infrastructure Management Systems* (e.g., Pärnu, Jelgava-Latvia).

2. The solution you are proposing

The Flood-Resilient Integrated City Governance solution represents an innovative tool built upon current state-of-the-art suite of flood management, as well as smart sensors and technological infrastructures. The solution is built upon the SaferPlaces (Global Platform AI-based Digital Twin Solution for Flood Risk Intelligence) that offers an advanced, scalable, and policy-relevant framework for supporting cities in the transition toward climate-resilient and flood-resilient urban systems. Main characteristics of the proposed solution are:

- Comprehensive multi-hazard coverage, including pluvial, fluvial, and coastal flooding, enabling coherent planning across multiple risk types.
- Cloud-based, high-performance modelling, enabling rapid scenario analysis and real-time flood simulations without the need for specialized local infrastructure.

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- Data-rich digital twin of the city, integrating geospatial, climate, and Earth-observation data to provide a high-fidelity representation of local flood drivers.
- Advanced AI-supported forecasting, providing real-time estimates of water levels and flood propagation that enhance early-warning capacities for civil-protection authorities.
- Data-process capacity for real-time monitoring of critical situations and timely intervention.
- User-friendly web platform and API enabling multilevel accessibility (e.g., municipalities, utilities, planners, insurers) and customization for technical partners (e.g., authorities, civil protection agencies, etc.).

3. Innovation and piloting of your pilot solution.

The proposed solution goes beyond existing tools by integrating hydrodynamic modeling, geospatial analysis, infrastructure monitoring, and citizen alerting into one interoperable platform that enables real-time data fusion and urban digital-twin simulations. Building upon current solutions and technology, the piloting intends to develop new functionalities, with particular focus on:

- **Smart sensors integration and real-time forecast**: The integration of Greenmetrics.ai's smart sensor network adds a new operational layer to SaferPlaces by providing continuous, hyper-local measurements of rainfall, upstream water-level dynamics and street-level flood detection. This innovative multi-layer system enables earlier interventions, supports practical automated safety measures (e.g. traffic controls, pump activation) and builds a long-term historical database that feeds into the city-specific predictive models.
- **Hazard modelling and systems interaction**: Development and validation of an innovative flood-forecasting module using Long Short-Term Memory (LSTM) neural networks to improve riverine flood-risk prediction. The module will feature an LSTM model trained on multi-year time series of upstream river-stage data and cumulative rainfall from hydrometric sensors. Continuous streams from rainfall, water-level, and flood-detection sensors will supply real-time observations to hydrodynamic models.
- **Multi-layer Integration**: Integration of existing information layers and Digital Twins of urban infrastructure to create a dynamic, multi-layer decision-support environment. By leveraging interoperable data streams, the system will simulate evolving scenarios and improve cross-sector coordination, enabling optimized emergency-resource allocation and timely identification of at-risk critical facilities.
- **Citizen awareness and response**: Development and integration of a multi-channel citizen communication layer within the platform (channels to be defined with cities). This layer is designed to bridge the gap between advanced forecasting and actionable public response, ensuring that critical flood information reaches the community in real-time and in an easily

understandable format. Alerts will be tailored based on the severity and location of the predicted flood. Furthermore, the project aims to foster a culture of preparedness to guide effective citizen action.

What do the cities need for piloting: Cities will facilitate access to and integration of existing datasets (e.g., DTM, building footprints and heights, monitoring stations) as well as new data. They will also provide access to existing Digital Twins of key infrastructures such as drainage, energy, and transport networks. Pilot development will be carried out in close collaboration with local authorities responsible for environment, urban planning, and innovation.

Capabilities of the research and development proposed team: Our international team brings together expertise across multidisciplinary areas: hydrology, hydro-informatic and engineering – Alessio Domeneghetti, Armando Brath (Univ. of Bologna); embedded and wireless electronic systems, including sensors, cellular and non-cellular wireless connectivity, edge computing - S. Pourmohammad Azizi (National Taiwan Ocean University); computer science and AI - Avleen Kaur Malhi, Mahtab Shahin (TalTech); smart sustainable cities and urban planning – Luiza S Azambuja (FinEst Centre), Lauriana Sapienza (Univ. of Bologna), Laura Mrosla (TalTech). The team also includes two private companies:

- Saferplaces.co – its solutions are adopted by several civil protection agencies and emergency authorities supporting risk assessment and monitoring, early warning systems, and plan evacuation actions (Stefano Bagli, stefano.bagli@gecosistema.com, Rimini, Italy).
- Greenmetrics.ai- it has Early Flood Warning Systems in operation in 15 cities in Portugal and Brazil, with +100 successful detection cases. It provides a full-stack service from software and hardware development, to field installation and maintenance (Tiago Marques, info@greenmetrics.ai, Lisbon, Portugal).

4. Expected impact of your pilot solution.

The platform will address key urban challenges and strengthen cities' resilience to natural hazards. Designed to be scalable (across space and time) and adaptable to specific urban contexts and requirements (application modules can be tailored to specific scopes) it will serve as a:

- Dynamic decision-support system enabling stakeholders to test and compare structural, nature-based, and hybrid mitigation measures.
- Natural hazard impact assessment tool supporting cost–benefit analysis and investment prioritization for both public and private decision-makers.
- User-friendly, multi-level interface accessible to municipalities, utilities, planners, and civil protection agencies via a web platform and API, with configurable user permissions.