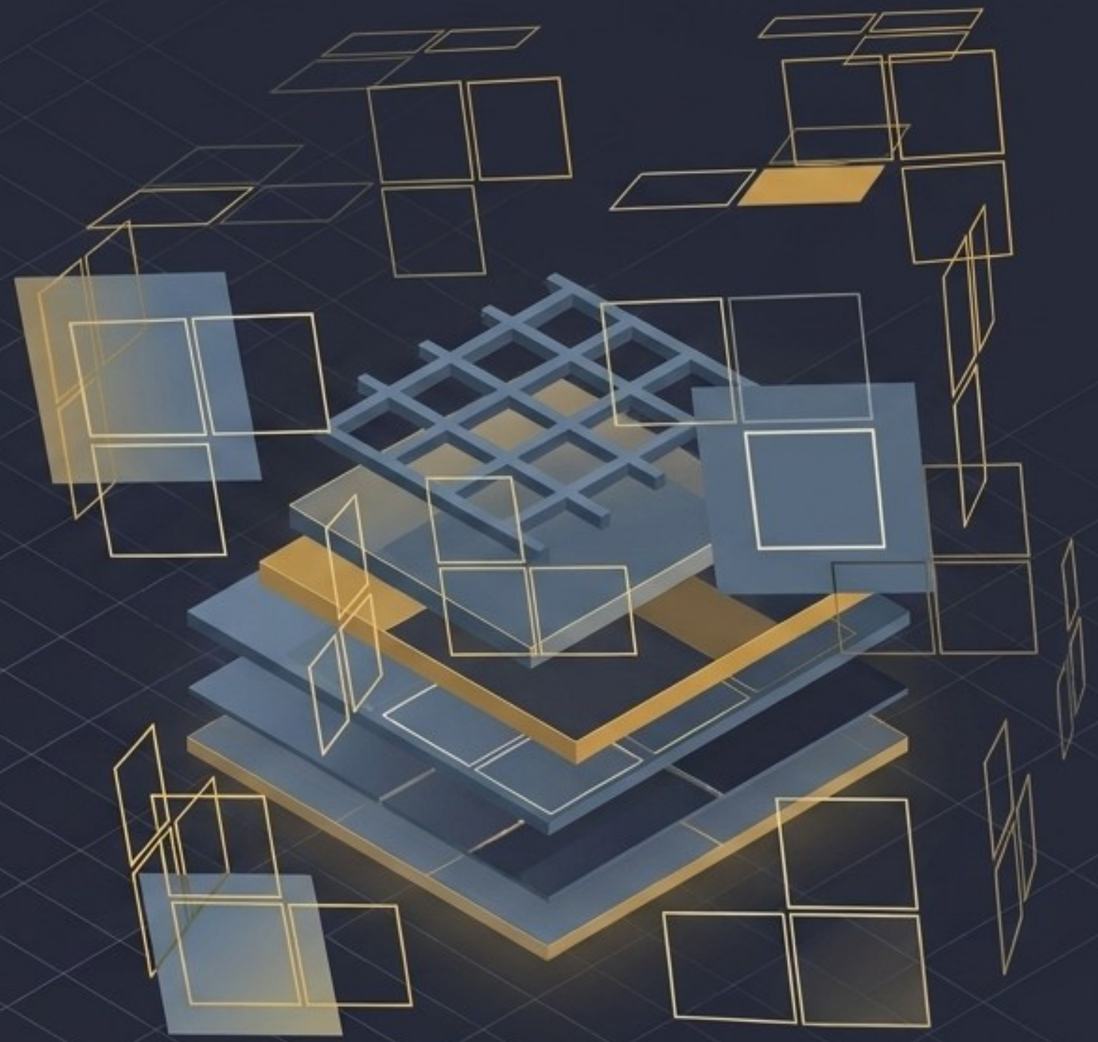
GWF
GEOSPATIAL WORLD FORUM

GeoAI & Digital Twin-based Predictive Systems for Future-proofing Urban Planning

April 2026



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ITC



- Combining technical and social sciences to make a difference in society
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GeoAI & Digital Twin-based Predictive Systems for Future-proofing Urban Planning



Cities are living systems managed by static tools.

- More than 75% of Europeans live in urban areas with escalating pressures from extreme heat, flooding, and shifting energy demands.
- Conventional Planning Support Systems, GIS or EO-based models are reactive and siloed.
- They map “what is” and “what was” but struggle to answer dynamic questions: Where can we build X,Y,Z given all competing constraints?

Reconceptualising the Digital Twin: From Observation to Reasoning

Dimension	Conventional PSS/GIS	AI-Empowered UDTs
Core Function	3D Visualisation & Data Storage	Dynamic Spatial Reasoning & Interpretation
System Output	Static Snapshots of current/past states	Adaptive Scenario Generation via Generative AI
User Role	Passive, expert-facing viewer	Active Co-Designer enabling multi-stakeholder governance
Planning Logic	Reactive and constraint-focused	Proactive Opportunity Finding

The Inverted Logic of Opportunity Finding

What is prohibited?



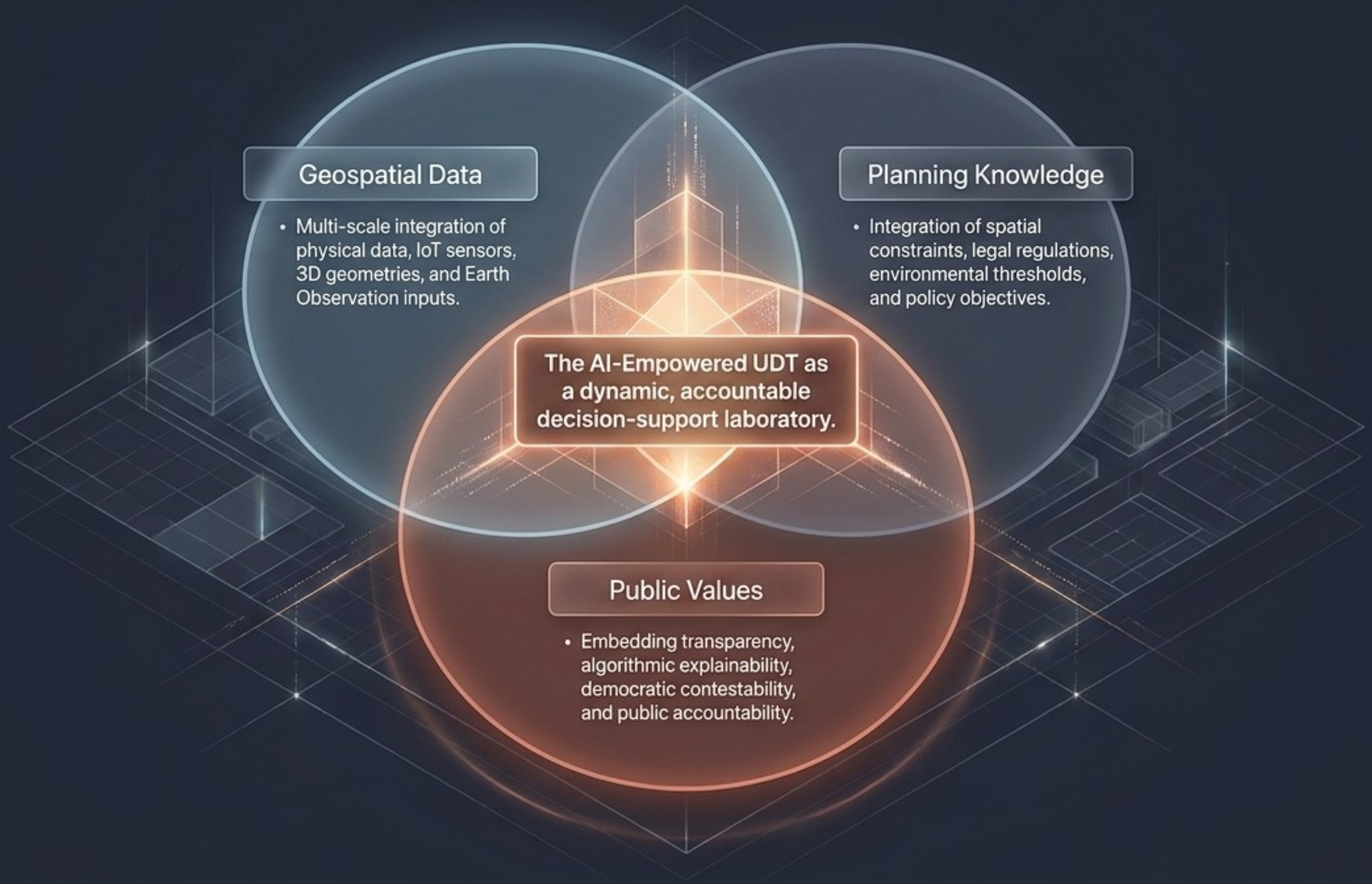
Sequential screening of constraints. Slow, cognitively demanding, and focused on limits.

Where is it feasible?

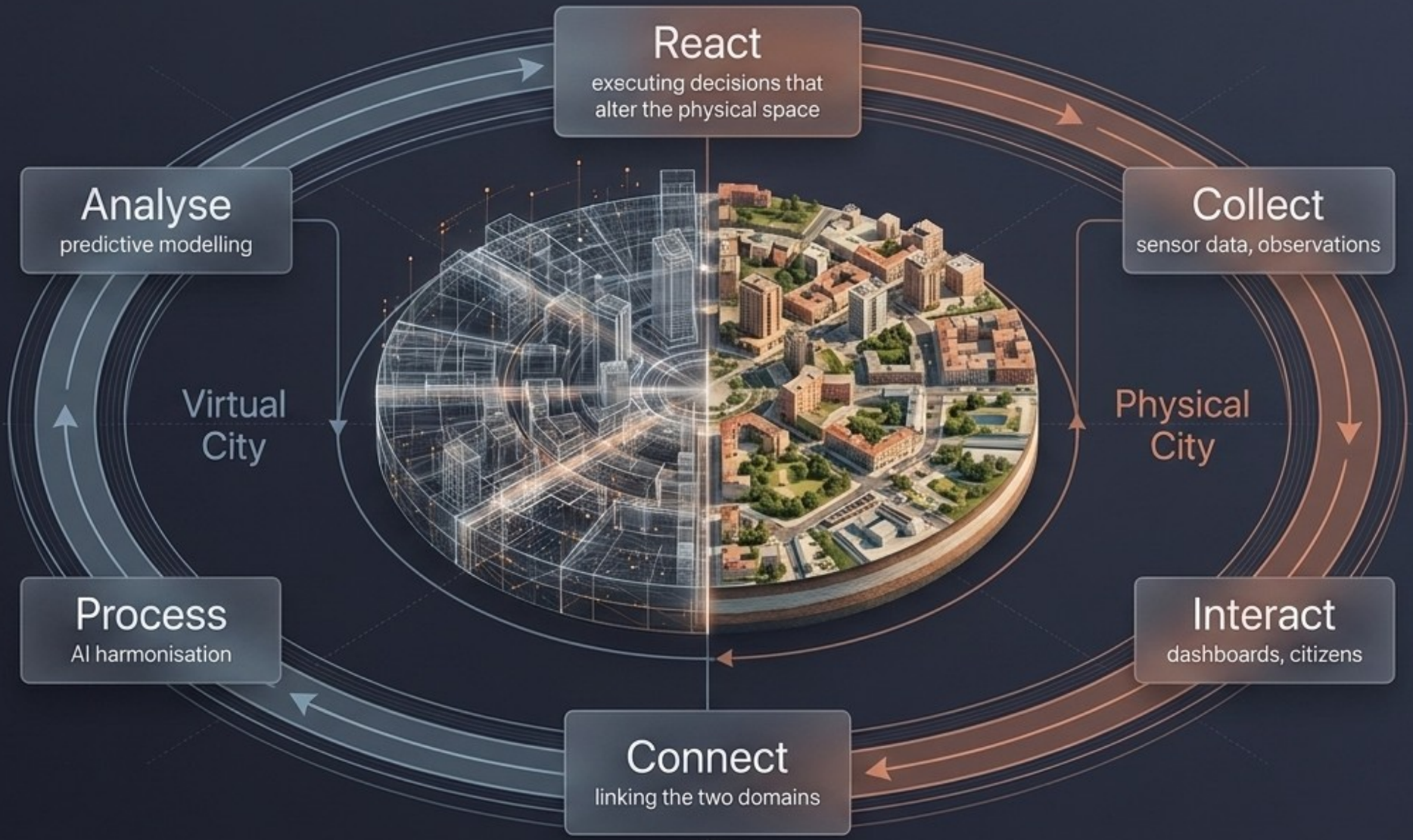


Proactive identification of spatial opportunities using natural language and AI reasoning.

Designing a Public Governance Instrument



The Continuous Urban Feedback Loop



The 6-Layer Architecture of an AI-Empowered UDT



Action & Output
Policy implementation, infrastructure management, and physical intervention.

Application
Domain-specific tools for energy, transport, climate.

Visualisation & Interaction
Dashboards, 3D environments, and Multi-Criteria Decision Analysis.

Analytics & Simulation
The core engine: LLMs and Generative AI for what-if scenarios.

Data Modelling & Semantics
Linking structured geometries with unstructured legal data.

Acquisition & Harmonisation
Gathering IoT, LiDAR, and satellite imagery; AI feature extraction.

The Analytical Engine: Multi-Domain Simulation



Time-series models (LSTMs) and Generative AI allow planners to test ‘what-if’ scenarios, forecasting the spatial consequences of specific policy interventions across all domain silos.

Real-World Proof: The Twekkelerveld Prototype

Context:

Post-war residential neighbourhood in Enschede, Netherlands.

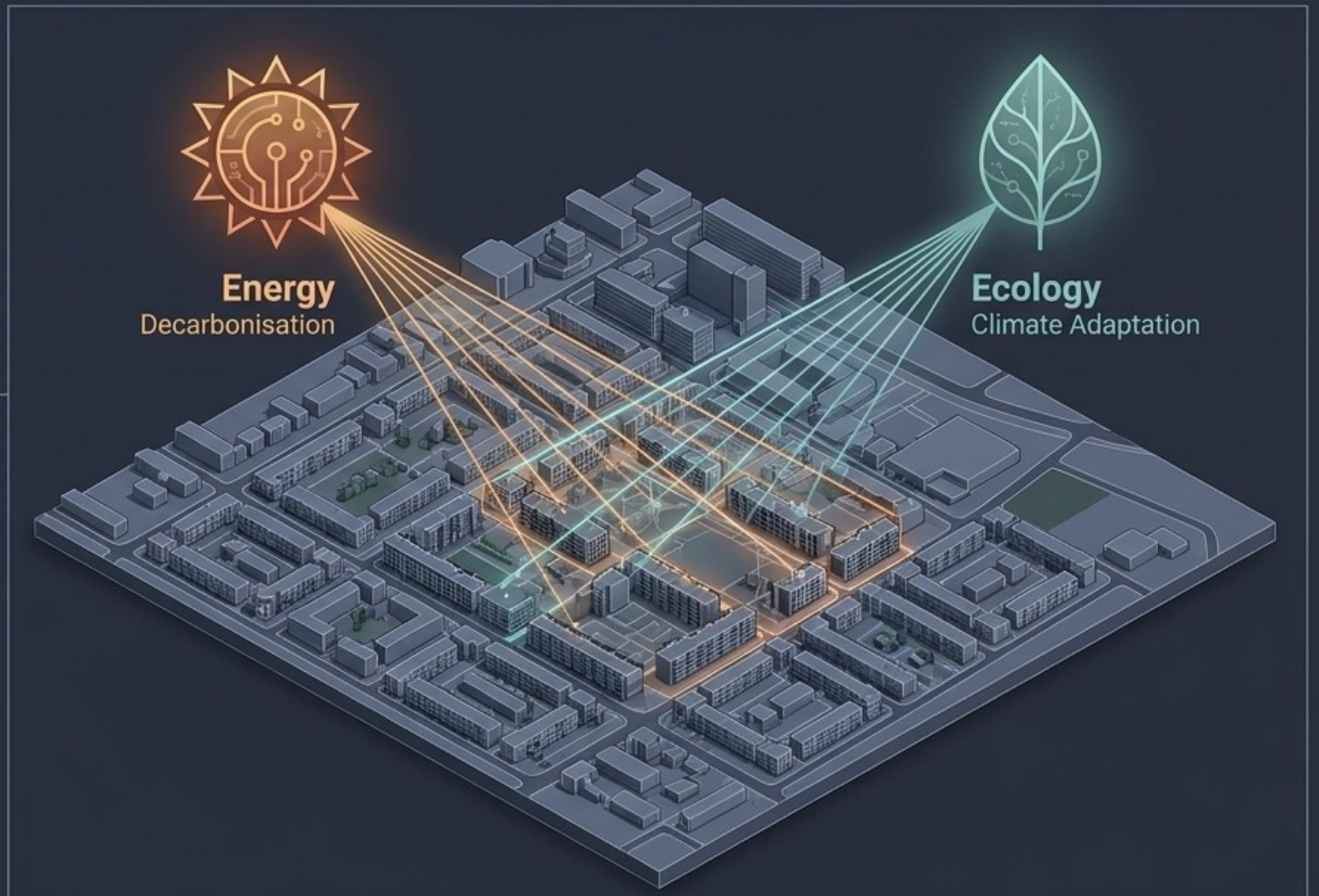
1,465 buildings analysed (78% constructed pre-1970).

The Conflict:

The neighbourhood faces immense pressure for both **Decarbonisation** (rooftop solar) and **Climate Adaptation** (urban cooling/tree planting).

The Baseline Reality:

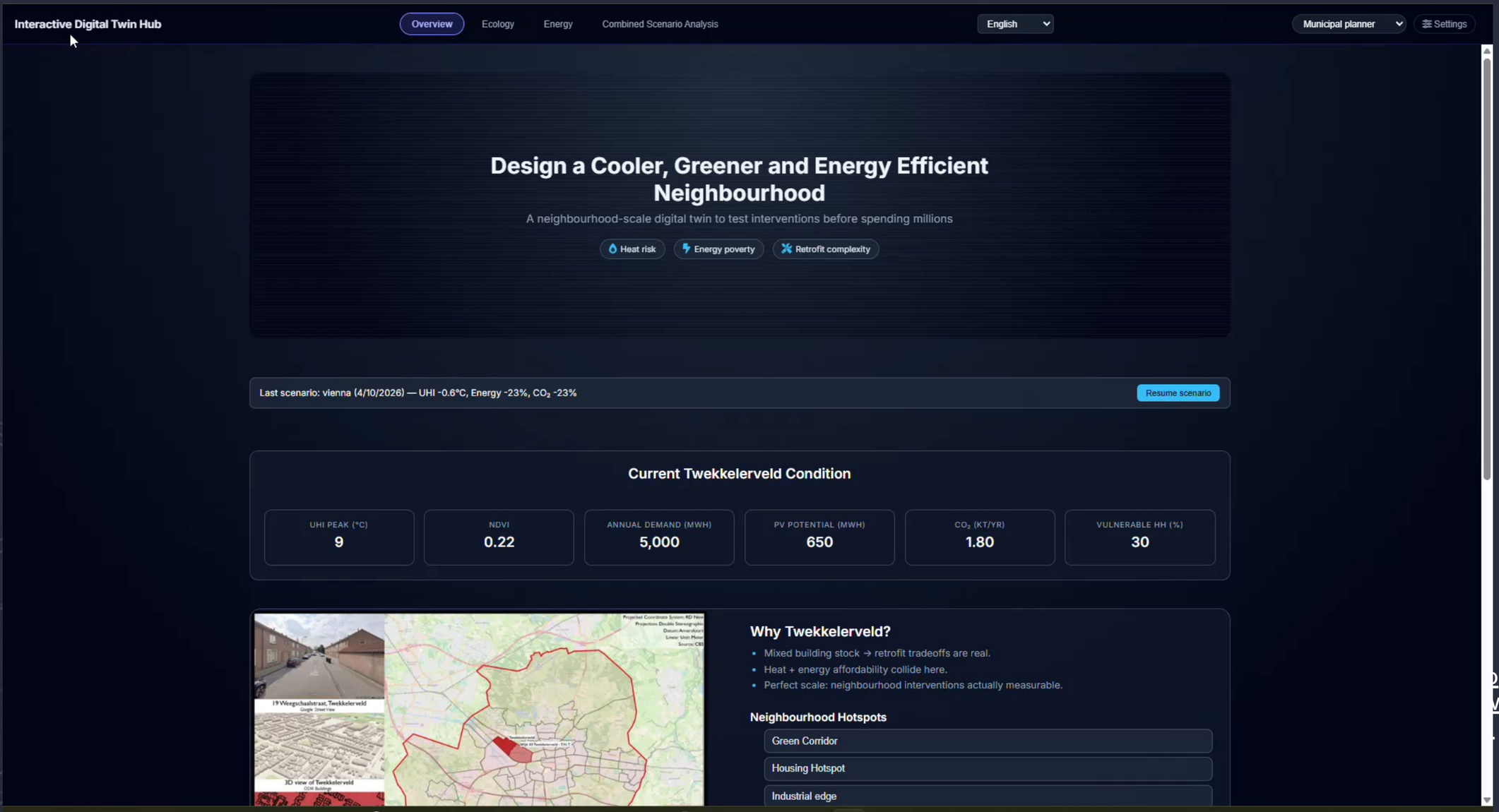
- Annual energy demand: **39.34 GWh/year.**
- Mean Land Surface Temperature (LST): **34.83°C.**
- Strong negative correlation between vegetation (NDVI) and heat exposure ($\rho = -0.448$).



Revealing Cross-Domain Trade-Offs



Digital Twin-based Prototype combining energy and ecology in support of spatial planning

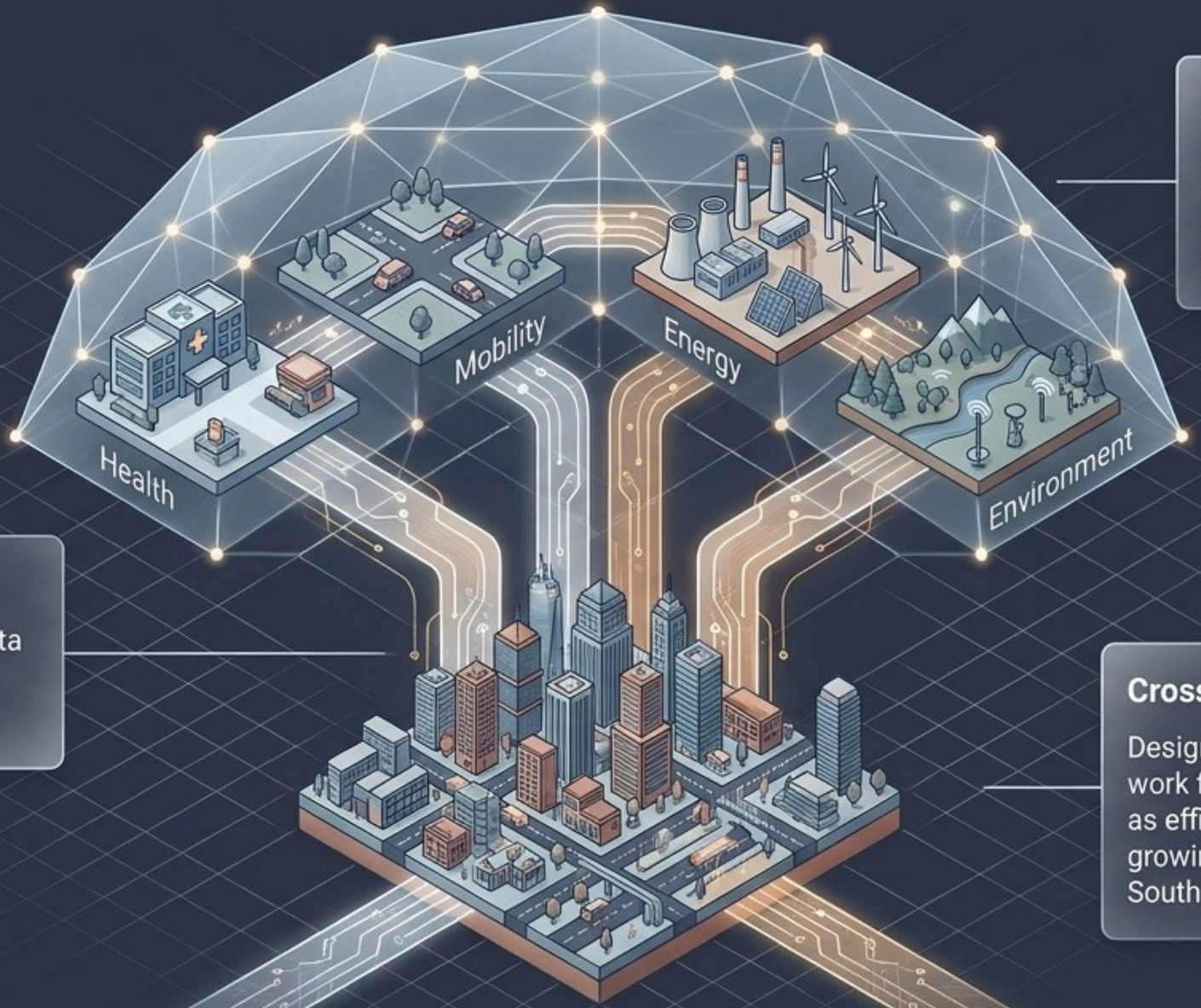


Scan to open the Digital Twin Prototype

GitHub Repository

github.com/RakibAthid/A-Neighbourhood-Scale-Urban-Digital-Twin-for-Energy-Ecology-Scenario-Planning

Scaling Up: Interoperability and Digital Sovereignty



European Values

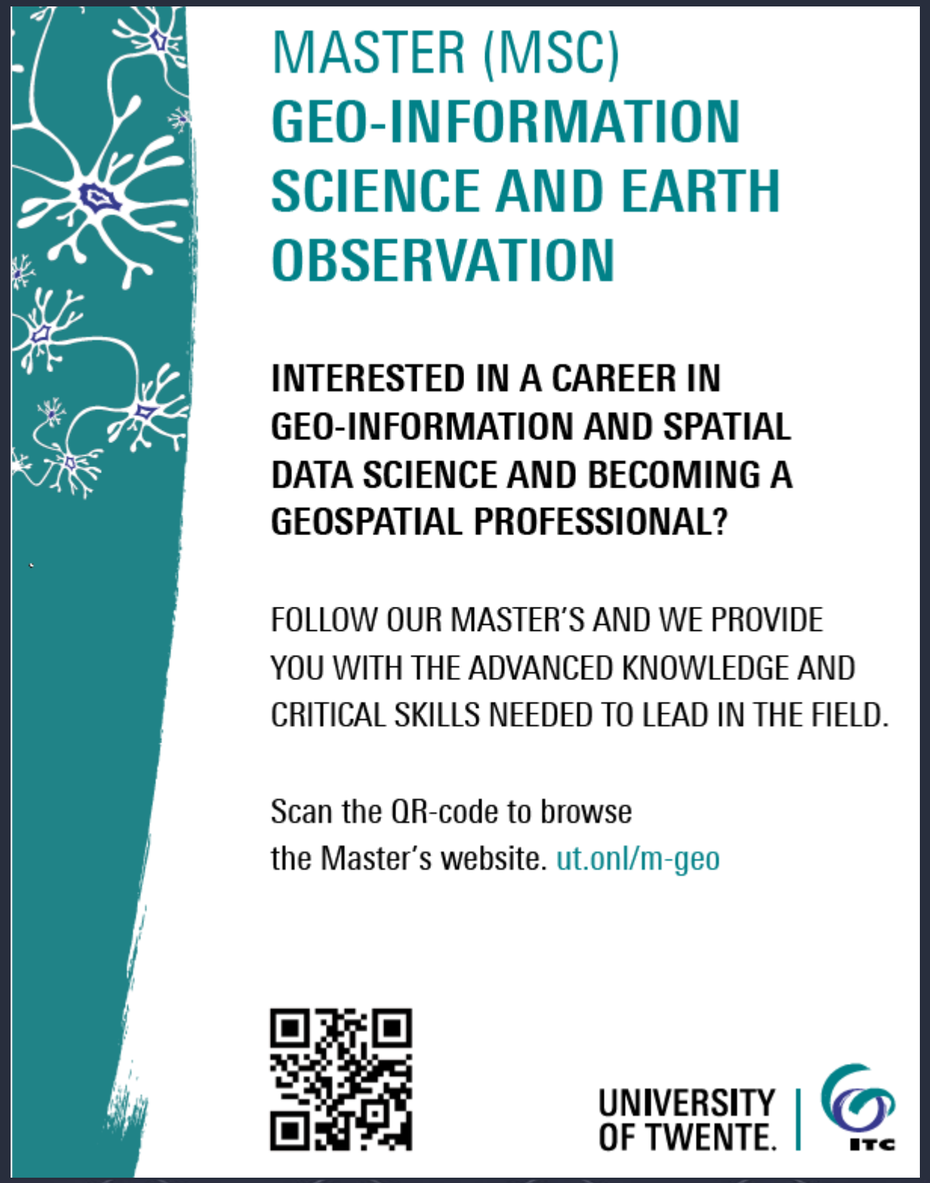
Ensuring AI models are open, auditable, and grounded in democratic accountability rather than proprietary black boxes.

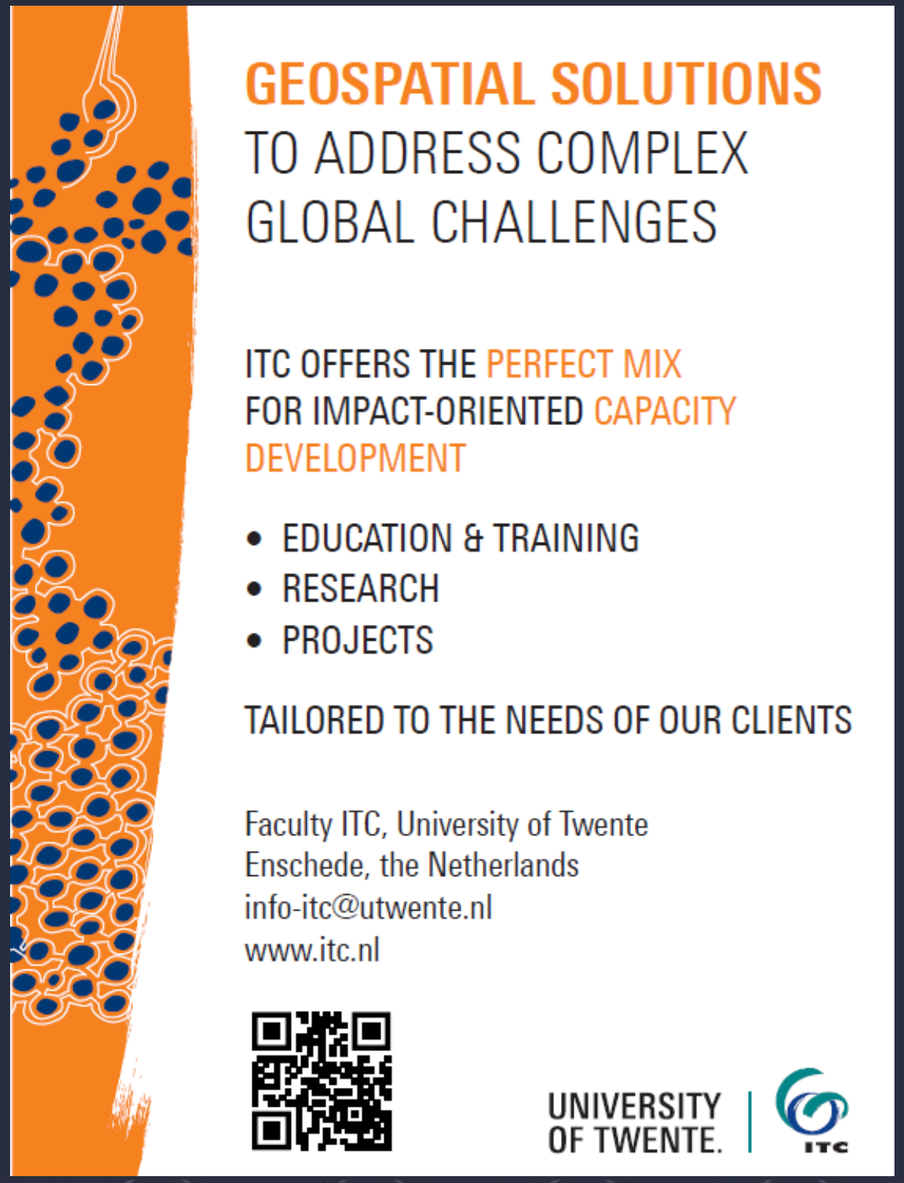
Federated Architecture

City-level twins exchanging data with regional and national frameworks like INSPIRE.

Cross-Context Transferability

Designing modular systems that work for dense European capitals as efficiently as they do for rapidly growing urban areas in the Global South.





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