ASHRAE Hellenic Chapter

SATURDAY

NOVEMBER 15, 2025

INTERNATIONAL CONFERENCE

ENERGY IN BUILDINGS ATHENS 2025

ΥΠΟ ΤΗΝ ΑΙΓΙΔΑ ΤΟΥ ΤΕΕ

- DECARBONIZATION & ENERGY SECURITY
- SUSTAINABILITY & GREEN TRANSITION
- ARTIFICIAL & BUILDING INTELLIGENCE
- ENERGY SAVING IN COMMERCIAL & INDUSTRIAL APPLICATIONS

09:00-18:00 | @ DIVANI CARAVEL HOTEL, ATHENS

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INTERNATIONAL CONFERENCE

ENERGY IN BUILDINGS ATHENS

ΥΠΟ ΤΗΝ ΑΙΓΙΔΑ ΤΕΕ

SATURDAY
NOVEMBER 15, 2025

Dr. DIMITRIOS ROVAS

PROFESSOR IN BUILDING SIMULATION AND OPTIMISATION
THE BARTLETT SCHOOL OF ENVIRONMENT, ENERGY AND RESOURCES
UNIVERSITY COLLEGE LONDON (UCL), UK

**«BUILDING OF THE FUTURE:
USING DIGITAL BUILDING TWINS FOR DATA-SMART OPERATION»**

09:00-18:00 | @ DIVANI CARAVEL HOTEL, ATHENS

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UCL East Campus

One Pool Street

A multi-functional building for community

- Office/Lecture/Retail/Accommodation
- Floor area: 16,500 m^2

In operation from September 2022

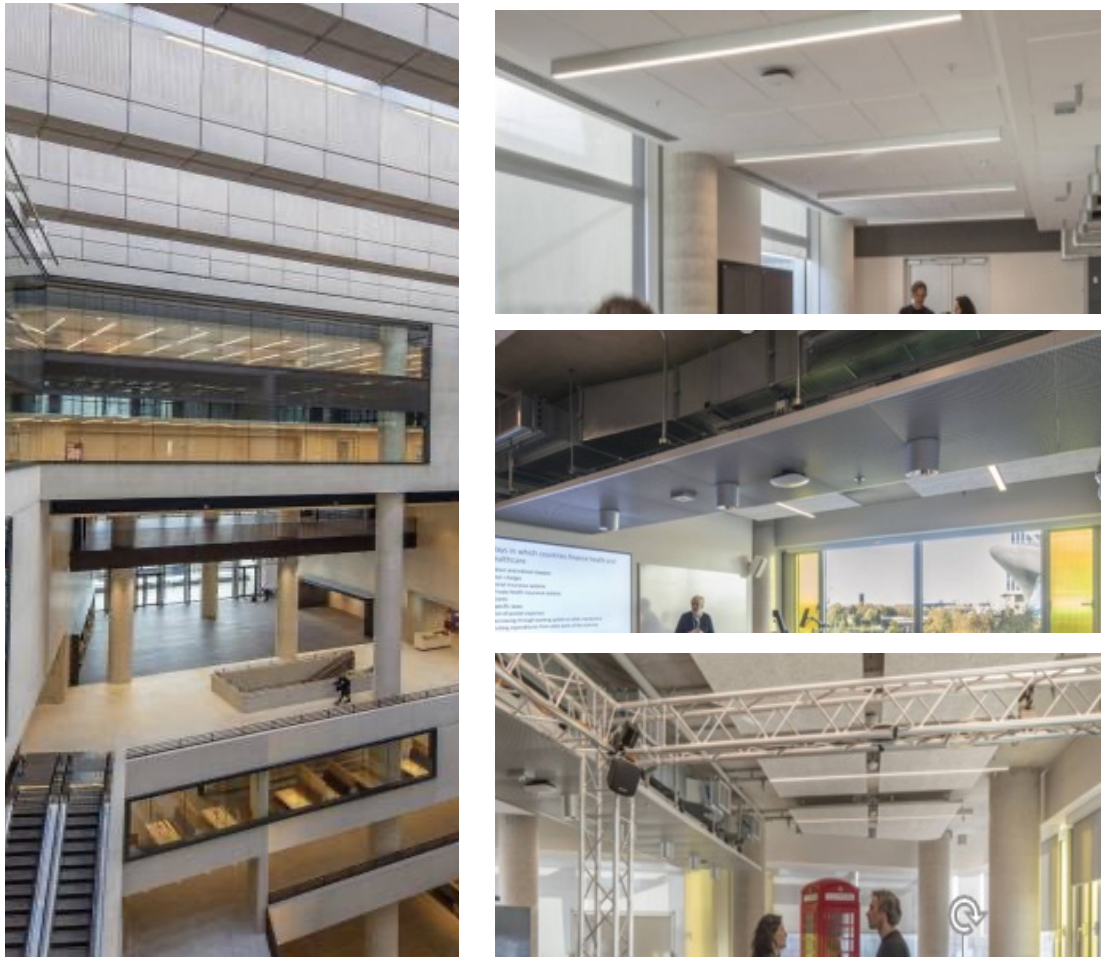
Marshgate

A building designed for collaboration

- Media/Retail/Workshop/Library/Lab
- Floor area: 35,000 m^2

In operation from September 2023

Building Environmental Elements



Complex system-of-systems, each building is different

HVAC systems

- ✓ Fully air-conditioned zones and heating-only zones
- ✓ Air-handling units, Variable Air Volume box
- ✓ Fan-coils, chilled beams
- ✓ Heating plants (low temperature hot water)
- ✓ Chiller plants
- ✓ Mechanical Ventilation with Heat Recovery

Building / system features

- ➢ Newly constructed buildings
- ➢ Large-scale & Complex building
- ➢ Diverse & advanced energy technologies

Building Management System (BMS)

- ➢ 6,000 real-time monitoring data points

One Pool Street: Over 3,000 data points for comprehensive building performance monitoring

IoT sensors in BMS

Electrical system
- ✓ Devices monitoring
- ✓ De-aerator unit

Occupant behaviors
- ✓ Lighting system
- ✓ Window monitoring
- ✓ Room monitoring

Domestic hot water
- ✓ Hot water unit
- ✓ Water storage tank

Cooling system
- ✓ Cold water set
- ✓ Chilled water unit
- ✓ Chiller unit

Heating system
- ✓ Trace heating
- ✓ Entrance door heater
- ✓ Heat Interface unit
- ✓ Heating monitoring

Ventilation system
- ✓ MVHR packaged unit
- ✓ Air conditioning unit

Data feature of BMS

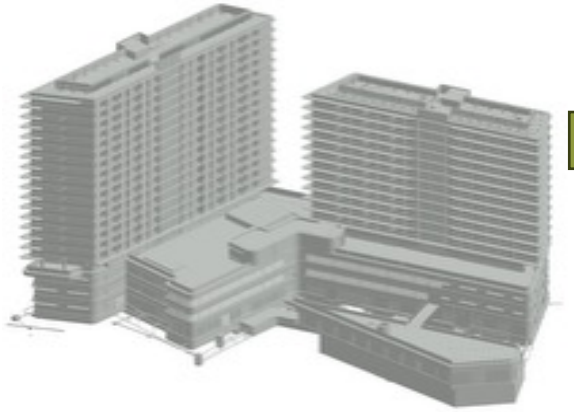
Signals of sensors
- ✓ Digital I/O & Analog I/O

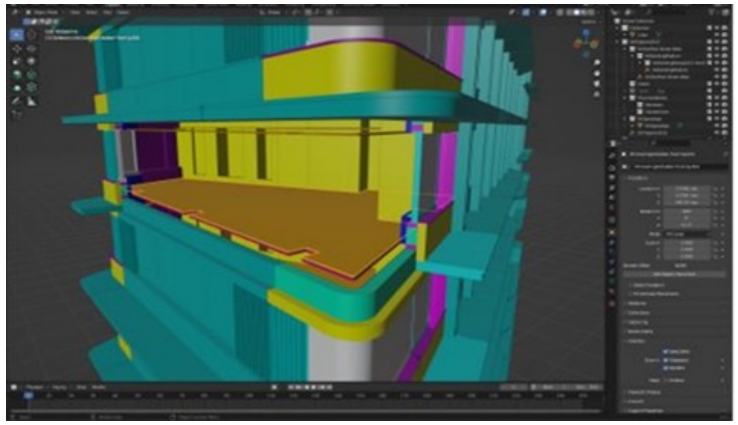
Data types
- ✓ Binary & Continuous

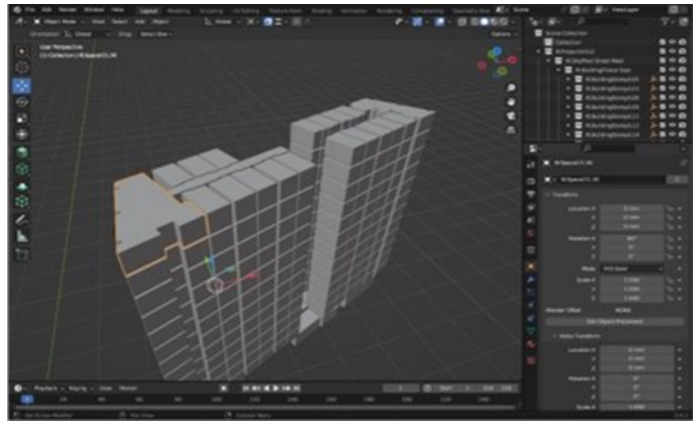
Monitoring points/parameters
- ✓ Speed
- ✓ Power
- ✓ Status
- ✓ Temperature
- .....
- ✓ Pressure
- ✓ Enable
- ✓ Flow volume
- ✓ Humidity
- .....

Information sources – Different contexts

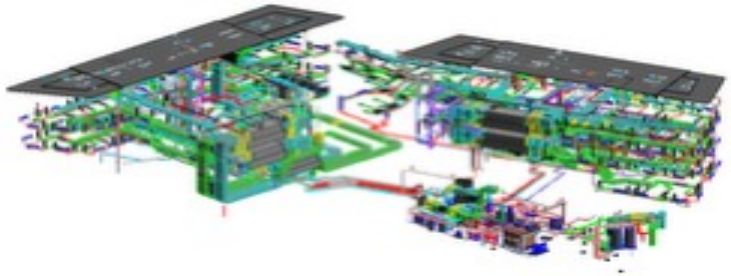
Architectural Context

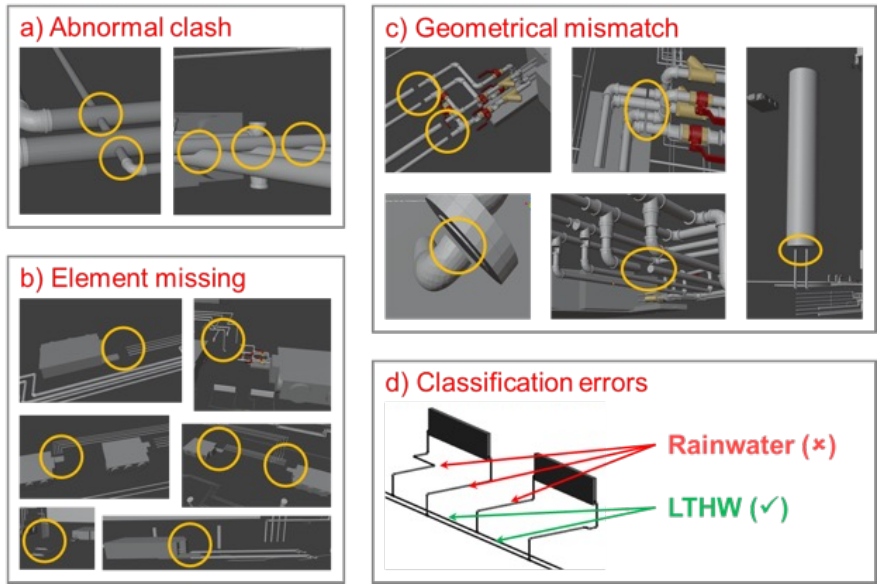






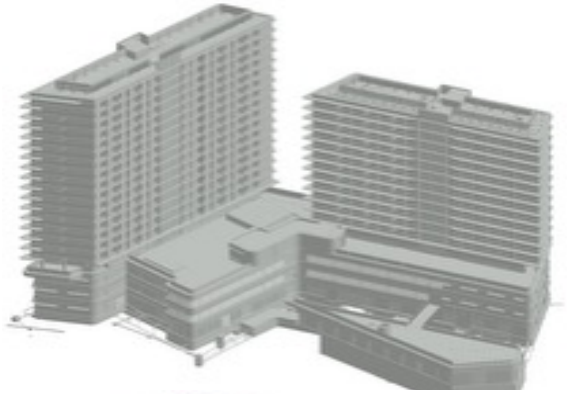
HVAC Context





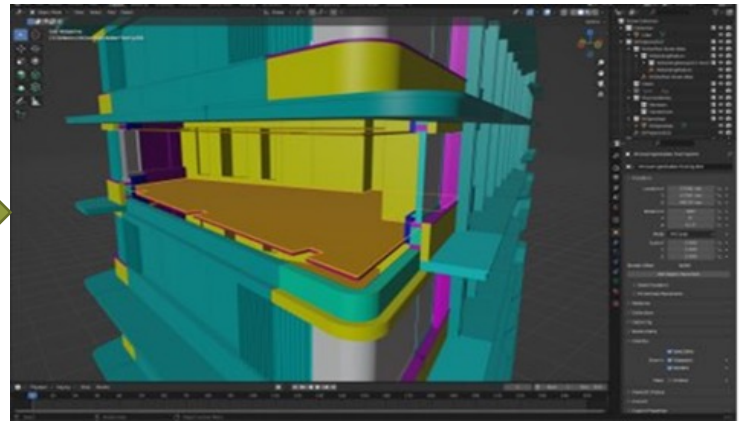
Information sources – Different contexts

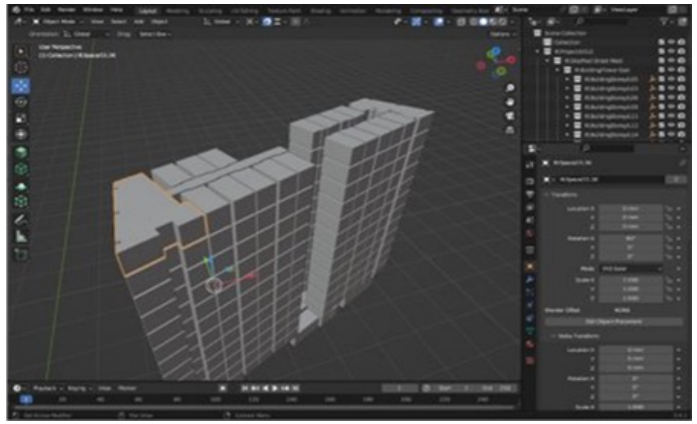
Architectural/Geometric context

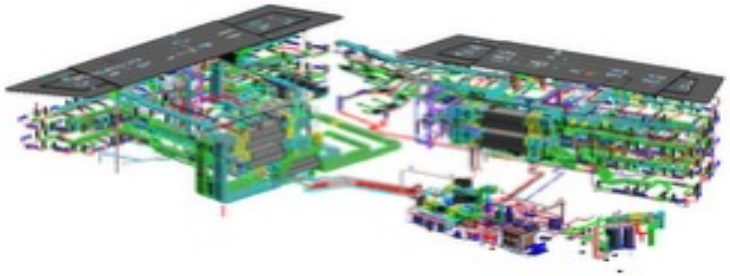


BIM
data quality

Check &
correction



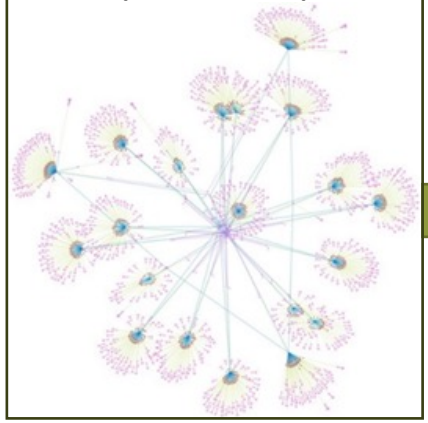




HVAC
Context

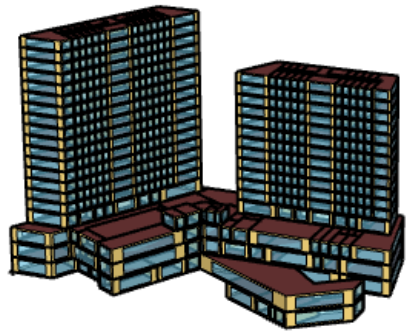
Knowledge graph
generation

Knowledge graph (Architectural)

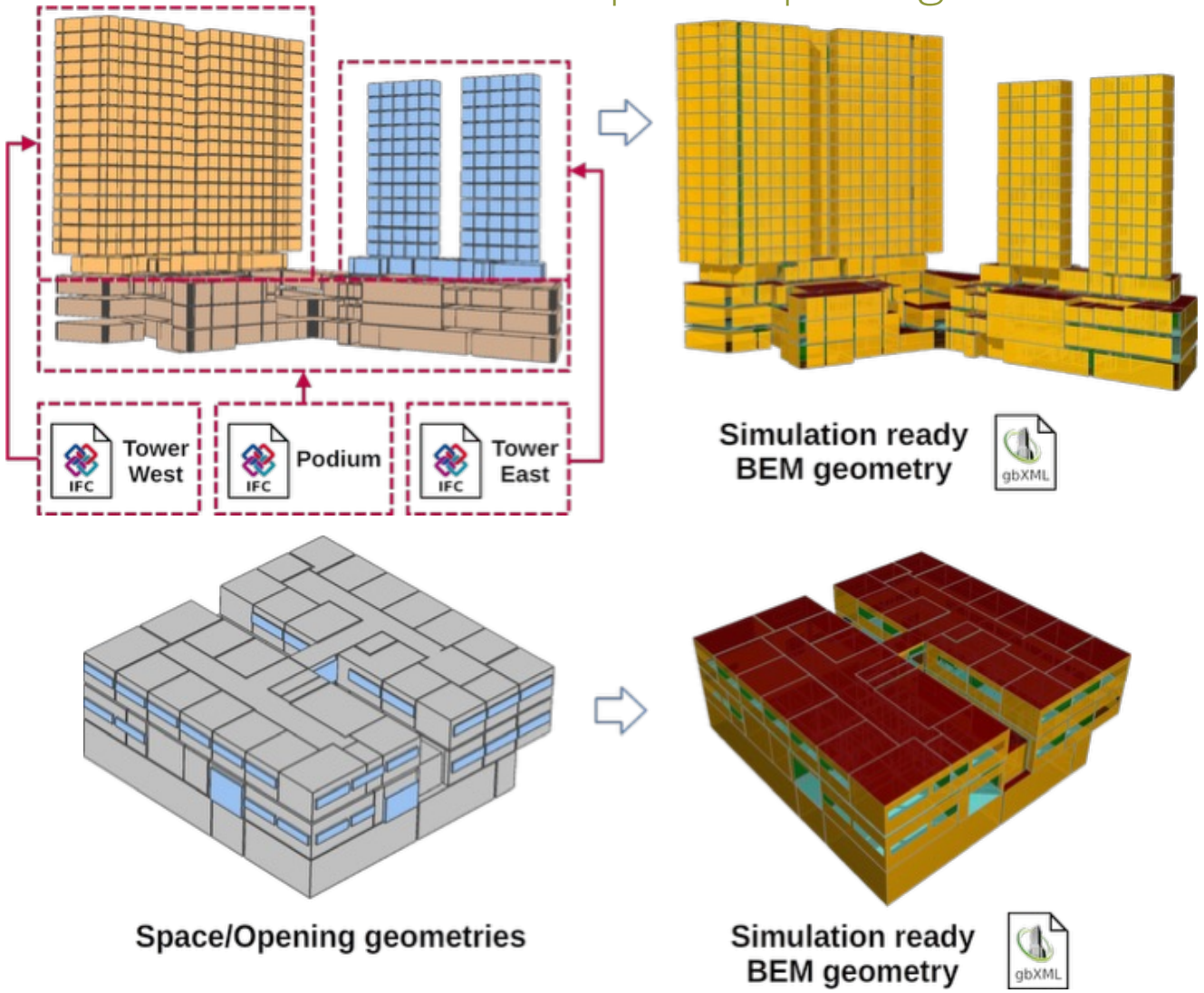


Model
generation

Building model in EnergyPlus



Architectural context -> Space/Openings IFC BIM -> BEM Geometry



- Minimum data quality checks (only space clash detection).
- Federated BIM data of large and complex buildings.
- Excellent opening handling capability (openings may not be aligned to the hosting walls).
- Identification of virtual space boundaries not detected by other methods (room partitions).

*G.N. Lilis, M. Wang, K. Katsigarakis, D. Mavrokapnidis, I. Korolijia and D. Rovas. *"Building Energy Model generation using BIM space and opening volumes."*(*submitted*

Information sources – Different contexts

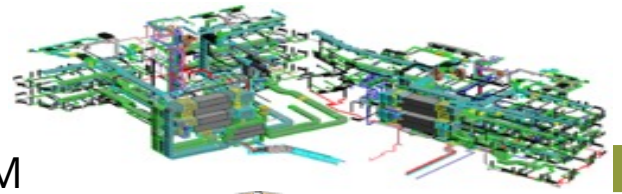
- A semi-automatic workflow from BIM to BEM with HVAC system.
- HVAC-related BIM always contain inaccuracies or design errors to hinder BIM2BEM transformations

Our solution – *Knowledge graph + Geometric relation checking*

MEP

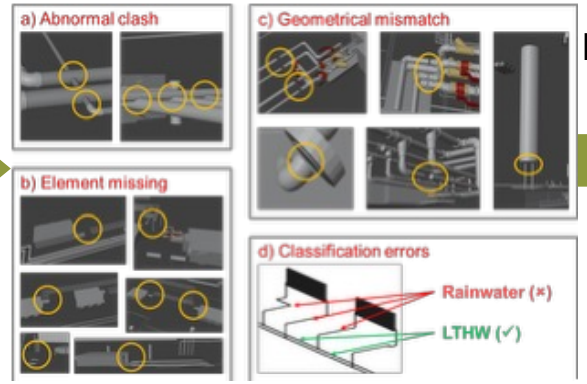
BIM

ARC



Geometry Relation Checker (GRC tool)

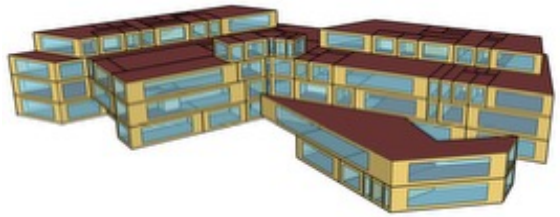
Error detection



Knowledge graph generator (KGG)

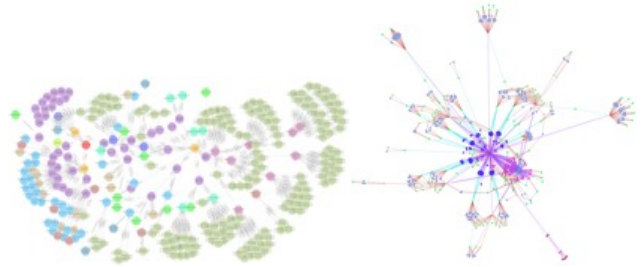
Ontology
Brick / REC
FSO / TSO
.....

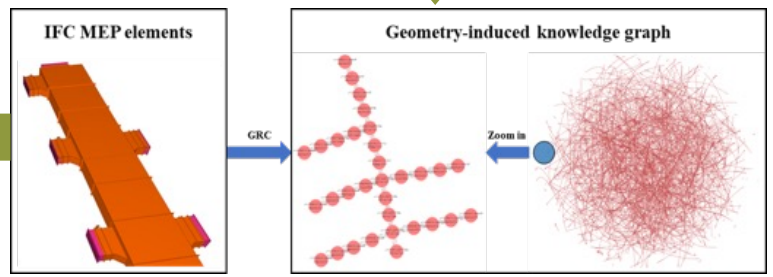
BIM-MP tool



E+ model (simulation-ready)

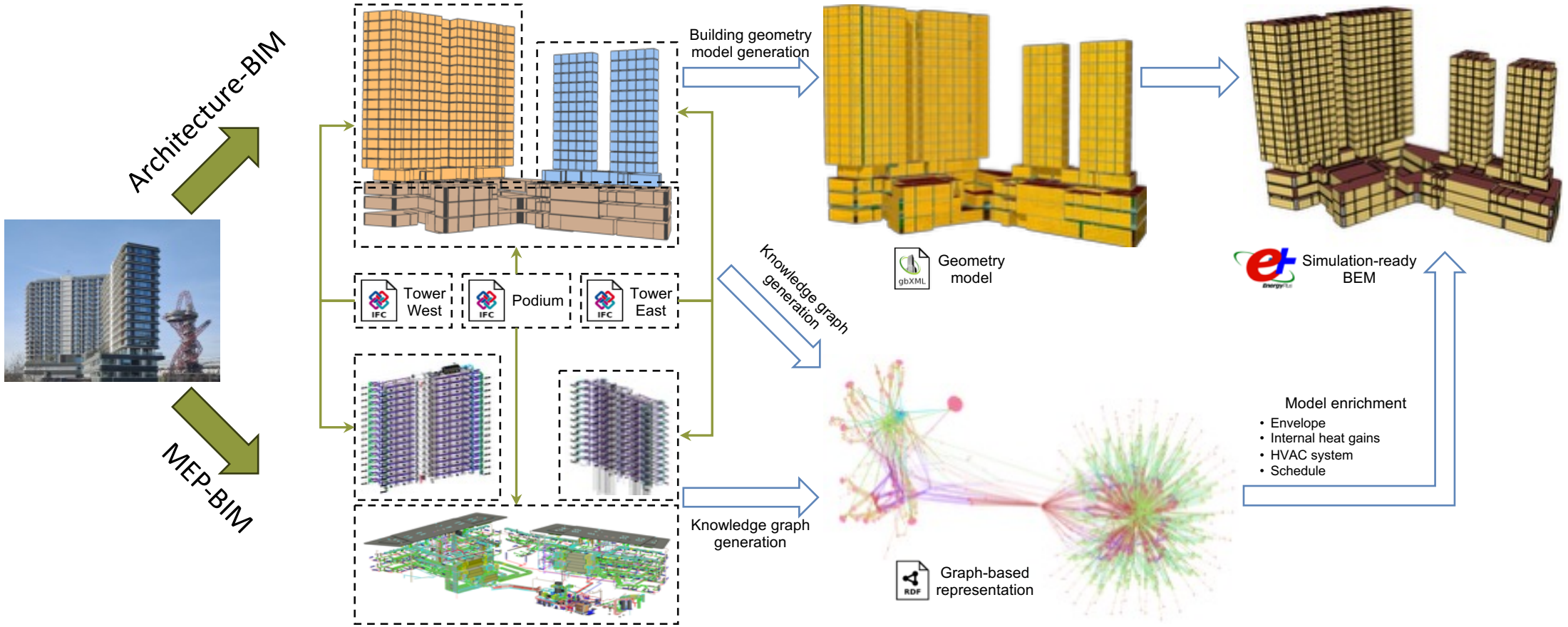
HVAC topology





Wang M., Lilis G., et al. A knowledge graph-based framework to automate the generation of building energy models using geometric relation checking and HVAC topology establishment, *Energy and buildings,* 2024. https://doi.org/10.1016/j.enbuild.2024.115035

From BIM to BEM: (Semi-)automated workflow.



From Design to O&M: Solving Facility Management Challenges with Digital Twins

- Resource constraints and cost efficiency
  → *Limited operational budgets and the need to reduce expenses per square meter ££/m²/Year*
- Complexity of systems and data silos
  → *Integration of multiple systems like BMS, IoT sensors*
- Maintenance and operational responsiveness
  → *Facilities must react quickly to issues without waiting for occupant complaints*
- Safety, compliance and resilience
  → *Ensuring compliance, safety protocols, and preparedness for unexpected event*
- Occupancy, space utilization and comfort
  → *Balancing energy efficiency with occupant comfort and accurate usage of spac*
- Sustainability and carbon goals
  → *Contributing to net-zero goals*
- Decision making and strategic planning
  → *Facility managers need reliable data to justify investments or changes*

How to manage a building of this complexity?

One Pool Street: Over 3,000 data points for comprehensive building performance monitoring

IoT sensors in BMS

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Occupant behaviors
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Data feature of BMS

Signals of sensors
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Data types
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Monitoring points/parameters
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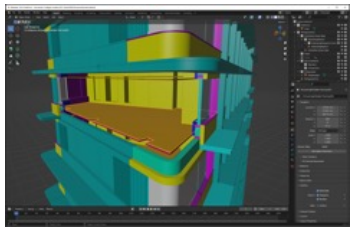
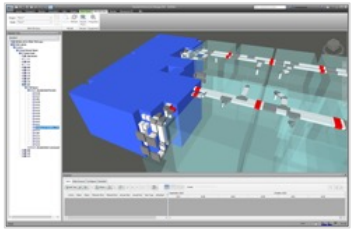
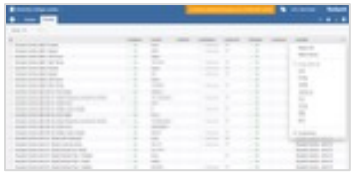
- .....

Data Integration: from heterogeneous data to a knowledge graph







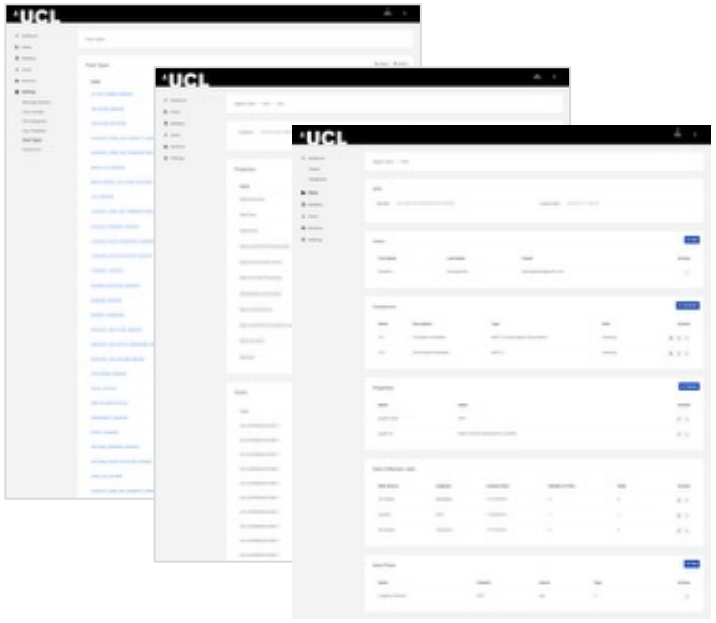
BIM Models

PDF

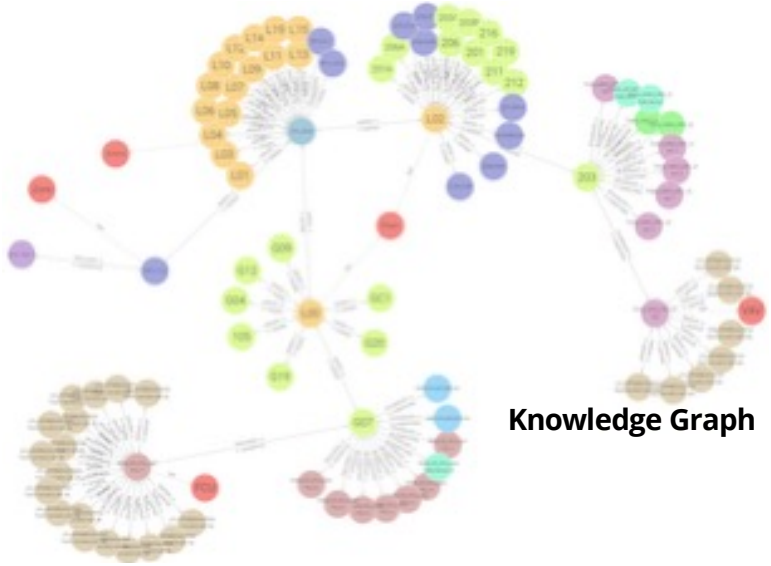
Documentation

Data Streams

Existing Data Models & Ontologies

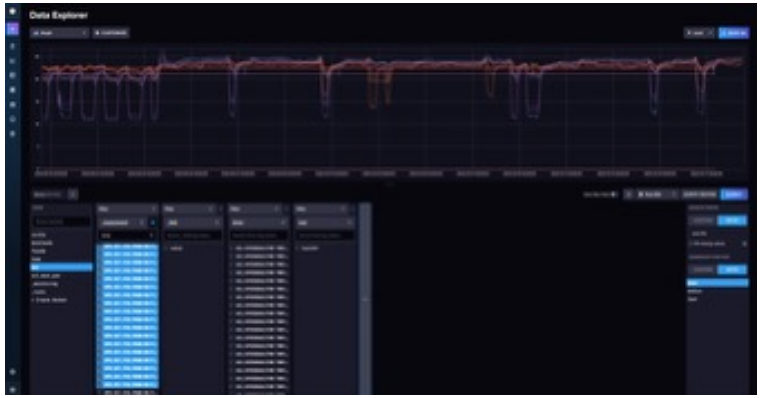


Data Integration, Management & Platform



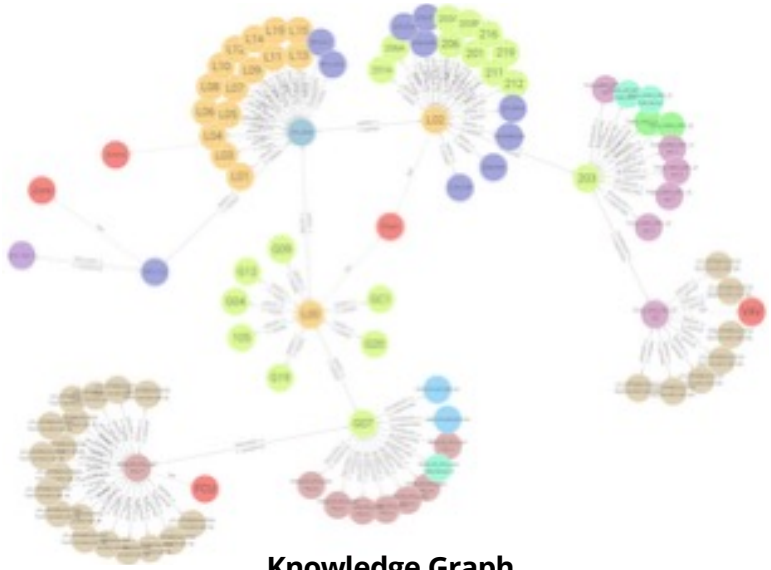
Knowledge Graph

Timeseries DB



Andrade Pereira, Flavia de, Kyriakos Katsigarakis, Nikos Kostis, and Dimitrios Rovas. 'A Hybrid Actor- and Microservices-Based Platform for Scalable Smart Building Application Deployment'. In Proceedings of the 11th ACM International Conference on Systems for Energy-Efficient Buildings, Cities, and Transportation, 291–96. BuildSys '24. New York, NY, USA: Association for Computing Machinery, 2024. https://doi.org/10.1145/3671127.3698788.

Data Integration: from heterogeneous data to a knowledge graph

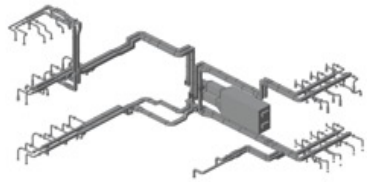


Knowledge Graph

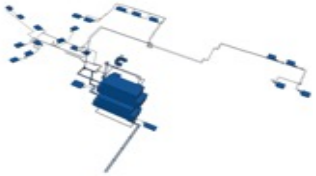
SPARQL

GraphQL

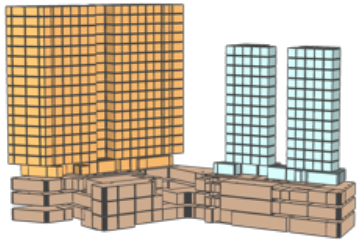
Universal Building API



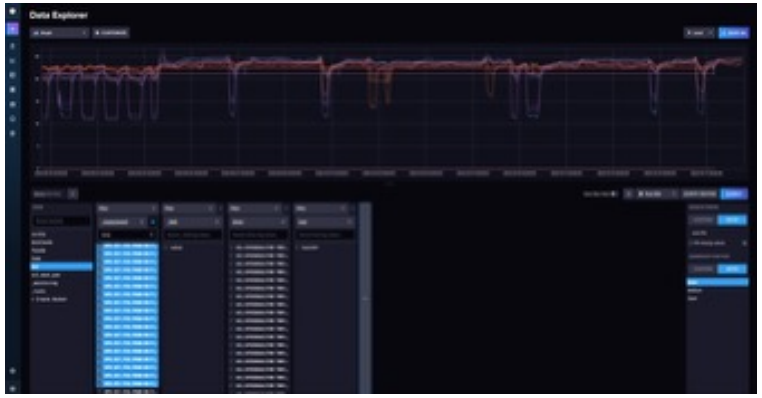
HVAC System Topologies



Water Loops



Energy Models

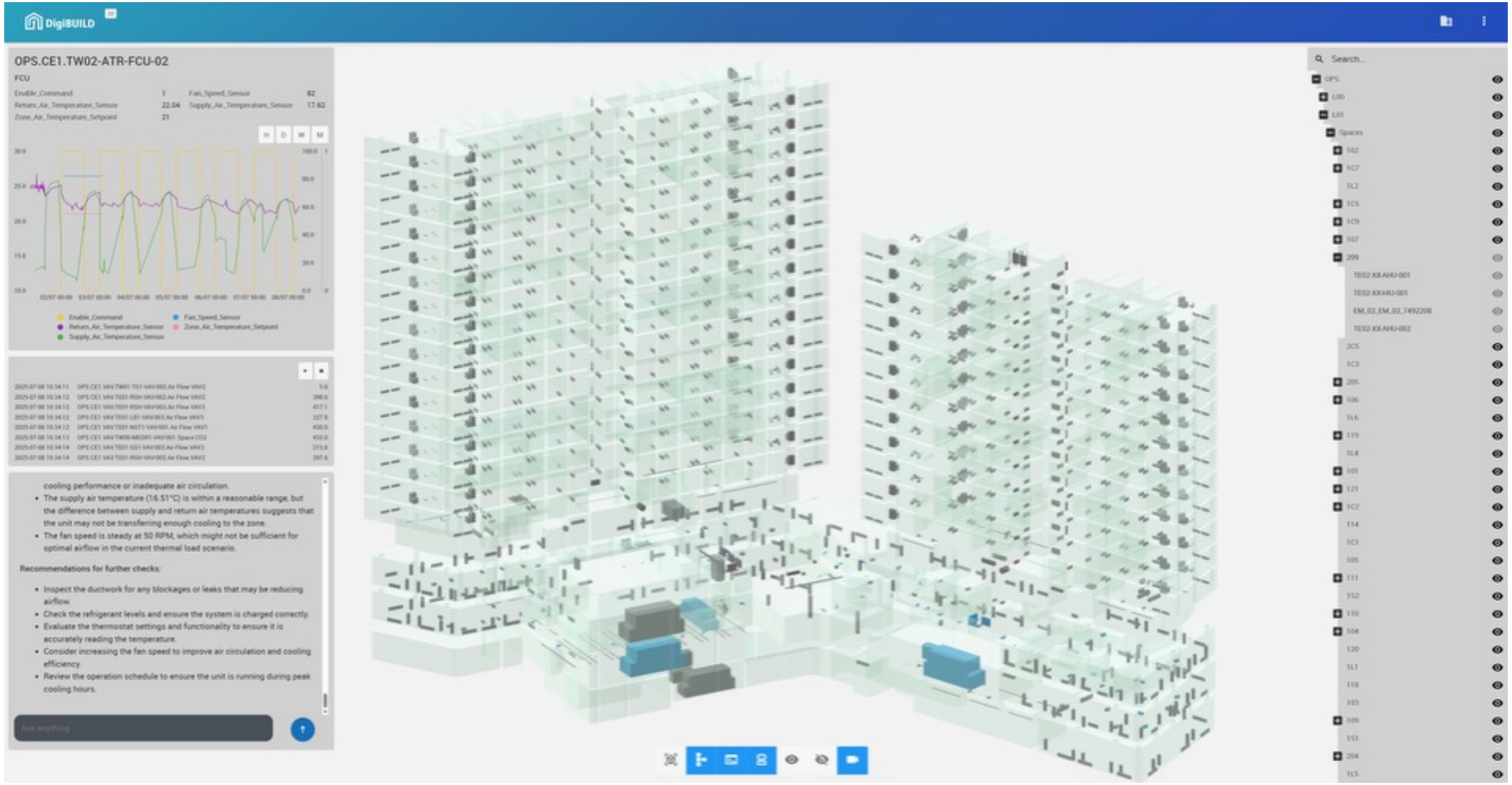


Timeseries DB

Digital Twin Visualisation Tools

Wang M., Lilis G., et al. A knowledge graph-based framework to automate the generation of building energy models using geometric relation checking and HVAC topology establishment, *Energy and buildings,* 2024**. https://doi.org/10.1016/j.enbuild.2024.115035**

Digital Twins for stakeholders



For more information

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H. Sayegh and EDF collaborators
DigiBuild and BuildON project collaborators


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ΥΠΟ ΤΗΝ ΑΙΓΙΔΑ ΤΟΥ ΤΕΕ
THANK YOU!
Q & A
NAME: Dimitrios Rovas
EMAIL: d.rovas@ucl.ac.uk
09:00-18:00 | @ DIVANI CARAVEL HOTEL, ATHENS
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