BIM4EEB

BIM-based toolkit for
Efficient rEnovation in Buildings

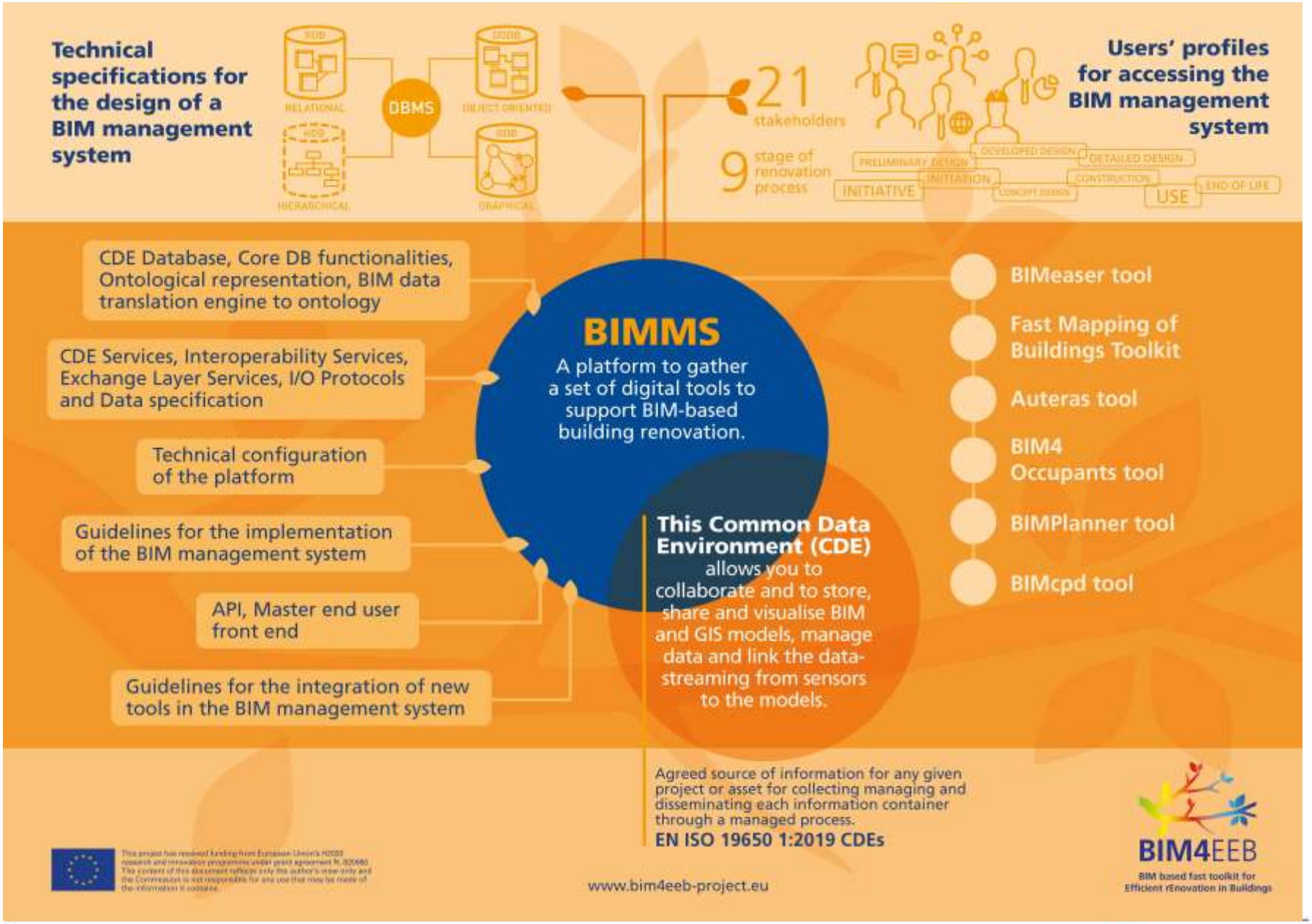
Interim Conference

29th October
Sustainable Places 2020

This project has received funding from European Union's H2020 research and innovation programme under grant agreement N. 820660

Agenda

14:00 - 14:15	**Introduction** *Cecilia Maria Bolognesi, Bruno Daniotti (PoliMi)*
14:15 - 14:45	**BIM-based toolkit for Efficient rEnovation in Buildings** *Bruno Daniotti (PoliMi)*
14:45 - 15:05	**The BIM Management System: an open Common Data Environment using Linked Data to support the efficient renovation in buildings** *Alessandro Valra, Davide Madeddu (One team)*
15:05 – 15:15	Poll and Questions and Answers session
15:15 - 15:35	**Fast Mapping for Buildings AR-toolkit** *Birgitta Andersson (RISE), Per Andersson (CGI)*
15:35 – 15:45	Poll and Questions and Answers session
15:45 - 16:00	**Coffee break (15 minutes)**
16:00 - 16:30	**BIMcpd: A combined toolkit for constraint checking, performance evaluation and data management in building renovation projects** *Andriy Hryshchenko (UCC), Brian O'Regan (IERC)*
16:20 – 16:30	Poll and Questions and Answers session
16:30 - 16:50	**Towards BIM-enhanced renovation management tools with support to stakeholder interaction** *Seppo Törmä (VisuaLynk), Markku Kiviniemi (VTT), Kostas Tsatsakis (Suite5)*
16:50 – 17:00	Poll and Questions and Answers session
17:00 - 17:20	**Early stage energy refurbishment assessment tool for buildings using high-end BIM data** *Teemu Vesanen (VTT)*
17:20 -17:30	Poll and Questions and Answers session
17:30 - 18:00	**Closure** *Cecilia Maria Bolognesi (PoliMi)*


Technical specifications for the design of a BIM management system
RELATIONAL
DBMS
OBJECT ORIENTED
HIERARCHICAL
GRAPHICAL
21 stakeholders
9 stage of renovation process
Users' profiles for accessing the BIM management system
PRELIMINARY DESIGN
DEVELOPED DESIGN
DETAILED DESIGN
INITIATIVE
INITIATION
CONSTRUCTION
USE
END OF LIFE
CDE Database, Core DB functionalities, Ontological representation, BIM data translation engine to ontology
CDE Services, Interoperability Services, Exchange Layer Services, I/O Protocols and Data specification
Technical configuration of the platform
Guidelines for the implementation of the BIM management system
API, Master end user front end
Guidelines for the integration of new tools in the BIM management system
BIMMS
A platform to gather a set of digital tools to support BIM-based building renovation.
This Common Data Environment (CDE) allows you to collaborate and to store, share and visualise BIM and GIS models, manage data and link the data-streaming from sensors to the models.
BIMeaser tool
Fast Mapping of Buildings Toolkit
Auteras tool
BIM4 Occupants tool
BIMPlanner tool
BIMcpd tool
Agreed source of information for any given project or asset for collecting managing and disseminating each information container through a managed process.
EN ISO 19650 1:2019 CDEs
www.bim4eeb-project.eu
BIM4EEB
BIM based fast toolkit for Efficient rEnovation in Buildings

FAST MAPPING TOOLKIT

The tool incorporates a range of new tools developed to speed-up the scan-to-BIM process and to improve the data visualisation of an existing building by using Augmented Reality (AR).

Laser scan & sensor scan with the tool, are imported in an IFC-file in the HoloLens device and uploaded into a laptop and the **BIMMS**

You will be able to map an existing building in an efficient and effective way using

sensorstick

Augmented Reality Tool:
- for finding electrical cables
- to find studs and humidity inside the walls
- for finding magnetic materials
- to detect differences in temperature

headset

The headset will be the user interface with the tool providing all features available.

Architects, engineers, construction workers will be able to use the 3D digital representation to visualise the building including hidden elements inside walls such as wall studs, water pipes, and electrical ducts.

Point clouds **generated** by digital mapping and scanning can be imported in the toolkit.

The IFC file can be automatically **selected** on the hololens device.

You can **visualize** the point cloud in the editor; you can **create** a new IFC file from it.

Than you start a **scanning** process with sensorstick and controller.

- inductance
- electricity
- capacitance

The scan-to-BIM **process** provides a 3D digital representation of the building including hidden elements inside walls.

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BIM4EEB
BIM based fast toolkit for Efficient rEnovation in Buildings

BIMcpd

A combined toolkit for constraint checking, performance evaluation and data management in building renovation projects; it is a user-friendly self-intuitive software suite that provides users with the necessary tools to carry out tasks in these areas.

WILL ALLOW USERS TO

FIND recommended positions for HVAC Heating, Ventilation and Air Conditioning, lighting and other devices.

COSTRAINT CHECKING TOOL

ANALYSE data from sensors, energy bills and other sources (weather for example).

PERFORMANCE ANALYSIS TOOL

- **Data viewer** for viewing data uploaded in the data management module and apply outlier detection methods to the data
- **Measurement and Verification** Measure and Verification devi mettere: for creating a baseline model of the building prior to the implementation of Energy Conservation Measures (ECM's) or building renovation

MANAGE the data that they have and create new data sets that they can share with other tools.

DATA MANAGEMENT TOOL

BIMCPD TOOLSET CONSISTS OF A RESPONSIVE WEB-BASED SOFTWARE

JavaScript PHP jQuery Python MySQL JSON

The tools developed in BIMcpd are designed to be used mostly by:


BIM Designer


Energy Auditor


M&V Practitioner


Administrator

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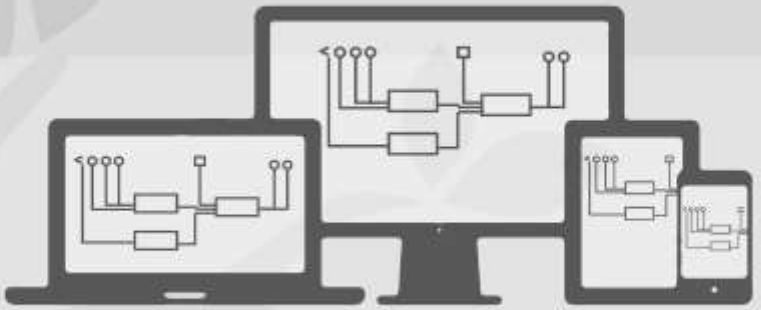
AUTERAS®

smart buildings | easy

Automated design of interoperable room automation systems

Auteras supports building services designers to design **Room Automation Systems** (as part of Building Automation Control Systems-BACS) with a semi-automated process of a functional requirement survey and the generation of function block-based designs, which use standardised symbols to ensure a high comprehension from professionals in different trades.



This tool is designed for building services designers.
It will free the planner and system integrator from time-consuming, costly tasks of planning and designing room automation systems (RA systems).

These activities can now be transferred to the computer, which can solve them independently and with optimal quality within seconds. In the form of the new room automation design tool AUTERAS, the design approach will shortly be available to all interested planners, system integrators and device manufacturers.

Functions of AUTERAS®:

- Generation of room automation schemes and function lists.
- Requirements elicitation.
- Automatic generation of RA schemes.
- Generation of optimized systems.

The resulting designs can be used directly to form bills of quantities for the procurement process. This tool imports and reads IFC information from existing buildings.

AUTERAS® suite:

- AUTERAS® PLAN
- AUTERAS® DESIGN
- AUTERAS® CATALOG
- AUTERAS® STORE
- AUTERAS® LITE

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www.bim4eeb-project.eu
www.auteras.de

BIM4EEB
BIM based fast toolkit for Efficient rEnovation in Buildings

THE BIM4OCCUPANTS

A web tool for building occupants

BIM4Occupants tool is a user friendly web based application that provides residents and/or owners with information related

- to their building renovation activities performed,
- to their indoor home conditions,
- to their comfort preferences and energy consumption.

Building occupants are supported to get insights about energy performance and environmental conditions.

They can get insights about the renovation tasks and activities running in premises and notified about security and safety conditions in premises.

The application has got two main features: the Occupants 2.0 and the Building 2.0

Occupants 2.0

provides access to real time and historical information about indoor and outdoor environment parameters (such as temperature, humidity, Illuminance, indoor air quality), as well as information regarding energy consumption.

Buildings 2.0

enables occupants to annotate information regarding building elements in their premises requested by contractors, contributing to the constant and collaborative updating of the BIM model and as-build documentation of their building.

BIM

Inhabitants receive information about on-site working planning and schedules, giving the contractors their needs and preferences

Building occupants, Inhabitants and Owners became part of the BIM4EEB project ecosystem and get insights about building performance in an intuitive way.

Occupants will be able to receive Health and Safety alerts and notification about the ongoing renovation processes within their building

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BIM4EEB

BIM based fast toolkit for Efficient rEnovation in Buildings

The BIMeaser

BIM Early Stage Energy Scenario tool
A web tool

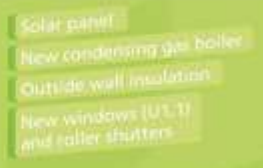
The tool is designed to support the decision-making process in the early design stage of the renovation process.

Linked Data can be used to enrich BIM models to enable decision making based on best possible models.

Scope of the BIMeaser-tool
Fill the gap between traditional process and sophisticated energy simulation needs.

The tool allows architects and engineers to provide solutions that best fit to the client requirements

while optimising the energy use and the indoor comfort for the occupants.



What are the main functionalities?

The BIMeaser tool enables the easy build-up of the "As-is" energy and indoor climate model of the building by using the BIM and linked data for accurate modelling in the early stage, where the most important design choices are made according to cost and performances.

The BIMeaser tool enables design teams to apply the renovation scenarios to the "As-is" building. It enhances the design team's collaborative work in the early design stage by providing an easy assessment of the multi-design domain alternatives.

BIMeaser tool presents the impact of each renovation scenario in terms of Owner Project Requirements (OPR). The design teams work collaboratively to validate the design selections against the OPR in each design stage. This is an important part of the performance-based building design process.

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BIM based fast toolkit for Efficient rEnovation in Buildings

Bruno Daniotti (PoliMi)

Introduction

A EU-funded project in a nutshell

BIM based fast toolkit **for E**fficient r**E**novation in **B**uildings

Duration:

- 42 months: 1 January 2019 – 30 June 2022

15 partners representing main stakeholders

- 3 Universities: PoliMi, UCC, TUD
- 2 Research Institutes: VTT, RISE,
- 2 Public administrations: Lombardy Region / ALER VCBM
- 4 SME/ Start-up: SOLINTEL, SUITE5, OneTeam, VisualLink
- 3 Large Enterprise: CAVERION, CGI Sverige, PROCHEM
- 1 EU Association ACE

The team: 15 Partners from 9 EU countries

Caverion

VTT

CGI

RI. SE
Research Institutes of Sweden

UCC
University College Cork, Ireland
Coláiste na hOllscoile Corcaigh

iERC
International Energy Research Centre

TECHNISCHE UNIVERSITÄT DRESDEN

PROCHEM
FINDING SOLUTIONS

Solintel

Suite5
We Deliver Intelligence

one team

Regione Lombardia

POLITECNICO
MILANO 1863

ALER
Azienda Lombarda per l'Edilizia Residenziale
di Varese - Como - Monza Brianza - Busto Arsizio

Partners' roles

Stakeholders' representatives

Building owner

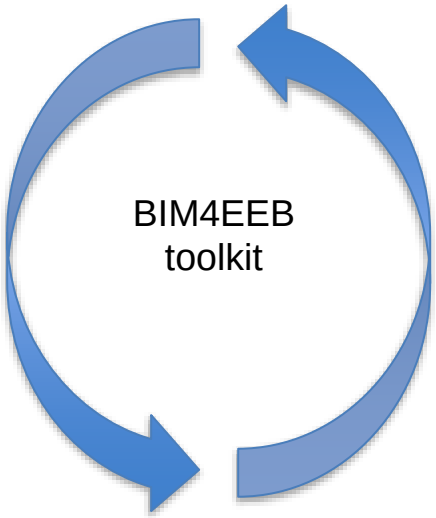
- Regione Lombardia
- SOLINTEL

Asset & facility manager

- ALER
- PROCHEM
- CAVERION

Architects' representative

- ACE



Tools developers

Industry

- One Team (SME)
- Suite5 (SME)
- Visualyink (SME)
- CGI

Research center

- VTT
- RI.SE
- IERC

University

- PoliMi
- TUD
- UCC

WHY BIM4EEB?

An EU-funded project supporting the renovation industry in retrofitting existing residential buildings with a complete **BIM-based toolkit to make the flow of information efficient and decrease intervention working time, while improving building performances, quality and comfort for inhabitants.**

These tools will allow to **rapidly reconstruct 3D digital models of existing buildings** and to seamlessly integrate semantic data in order to perform advanced evaluations of design options for renovations.

Main results will include **guidelines for BIM implementation** and providing an easy, practical and operational platform as a central repository of information, namely **Common Data Environment (CDE),** with different connected tools.

The BIM4EEB objectives

1. *Maximise efficiency in building renovation:*
2. *Accelerate the market uptake across Europe towards a digital built environment*
3. *Speed-up data gathering and processing*
4. *Interoperability of different stakeholders and tools, harmonising data exchange formats*

The BIM4EEB toolkit

Fast Mapping of Buildings

BIMPlanner

BIM4Occupants

BIMMS
BIM Management System

BIMeaser

Auteras

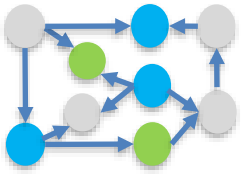
BIMcpd

Main phases

Phase 1

Construction & service companies

HVAC designers

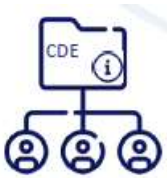


linked data & ontologies

owners & inhabitants

Requirements, linked data &ontologies

Phase 2



BIMMS

AR for fast mapping & survey

BIMplanner BIM4Occupants

Auteras, BIMcpd, BIMeaser

Tools development

Phase 3

Monza demo site (IT)

Chorzow demo site (PL)

Tampere demo site (FI)

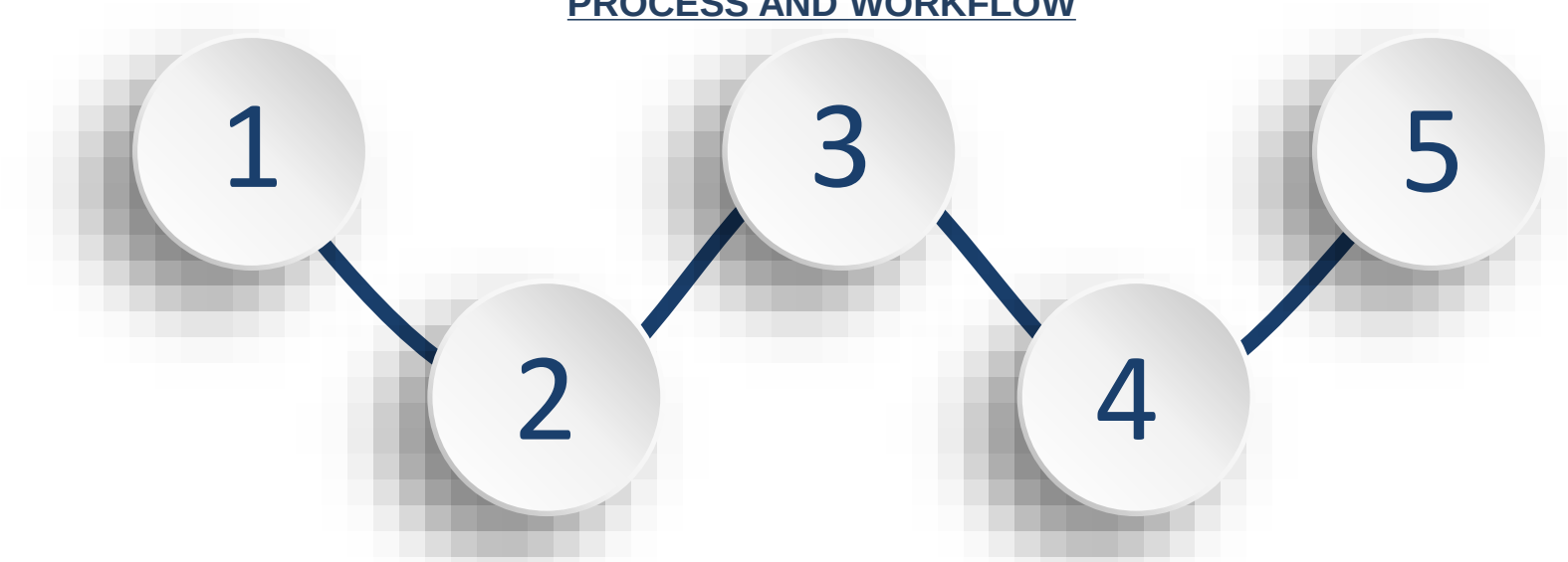
Demonstration in relevant environment

Definition of requirements for an efficient renovation process

TO DEFINE PRECISELY EVERY **ACTIVITY** THAT IS REQUIRED IN EACH STAGE OF A RENOVATION PROCESS

TO DEFINE THE MOST PROPER **INFORMATION EXCHANGE/SHARE PROCESS AND WORKFLOW**

OPTIMISATION OF THE RENOVATION PROCESS (i.e. to limit inefficiencies due to incorrect or redundant exchange of information)



TO POINT OUT THE **INVOLVED STAKEHOLDERS**
(as designers, architects, construction companies and service companies, but also owners and inhabitants) IN EACH SINGLE STAGE OF A RENOVATION PROCESS

TO INDIVIDUALISE **NECESSARY REQUIREMENTS** WHICH HAVE TO BE SATISFIED DURING RENOVATION INTERVENTIONS

Process analysis and definition of relevant activities and involved stakeholders (public vs private sectors)

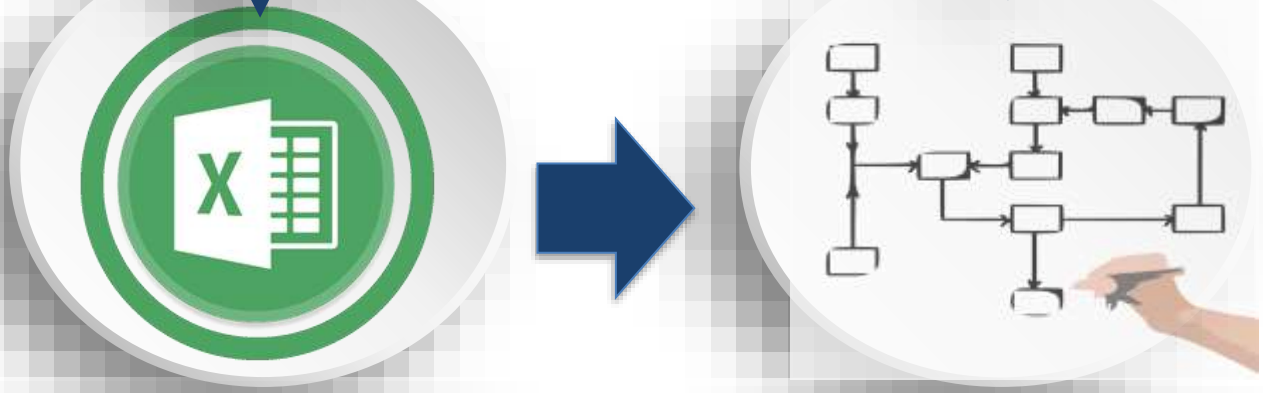
1. **WHO:** to individualize all the involved stakeholders
2. **MAKES:** the kind of activity that is undertaken
3. **WHAT:** to individualize to result of the activity
4. **WHEN:** to point out the stage when the activity happens
5. **WHERE:** to find out possible differences in different Countries

SHORTCUT: to underline possible optimisations to be considered along the process

Definition of relevant activities and involved stakeholders in actual and efficient renovation processes

FROM

TO



TABLES

FLOWCHART

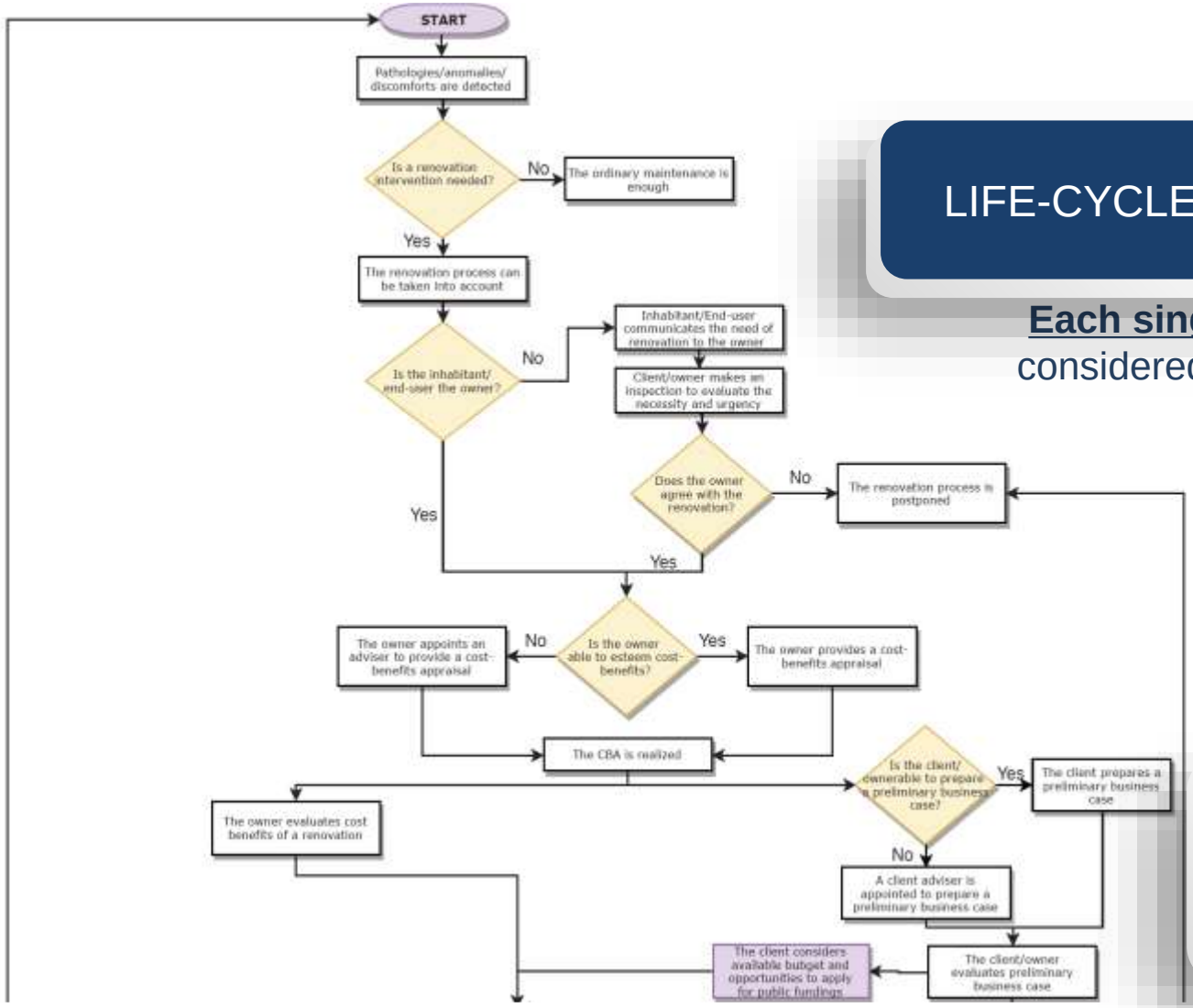
Relevant activities

In case of a residential renovation

Involved stakeholders

Public owner vs Private owner

Main output: Workflow in a renovation process



INITIATIVE

LIFE-CYCLE PERSPECTIVE

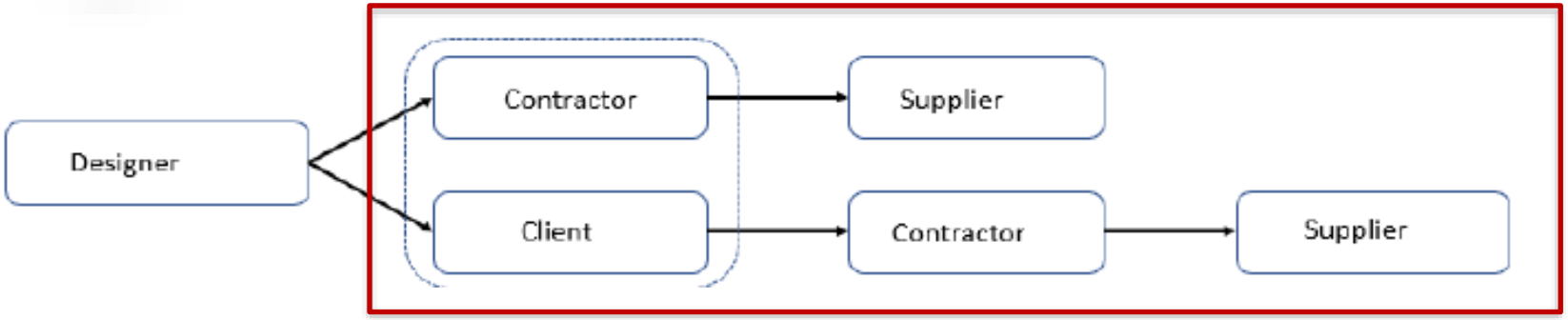
Each single stage was considered and analysed

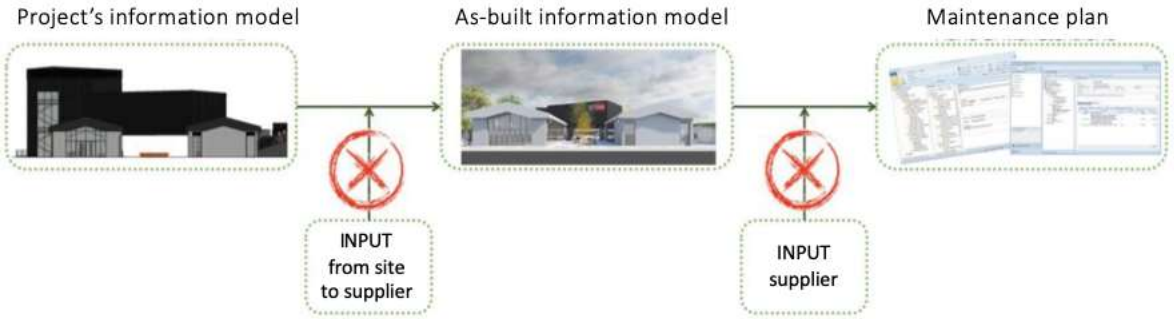
0. INITIATIVE
1. INITIATION
2. DESIGN
3. PROCUREMENT
4. CONSTRUCTION
5. USE
6. END OF LIFE

This is only the first portion of the workflow

Definition of construction companies' needs and requirements in renovation interventions

A SURVEY WAS DEVELOPED AND SHARED IN ORDER TO INDIVIDUALIZE INFORMATION REQUIREMENTS ALONG THIS INFORMATION WORKFLOW:





Example: lost of information in different stages due to a not digitized supplier

Definition of construction companies' needs and requirements in renovation interventions

INVOLVEMENT OF DIFFERENT ORGANISATIONS, ASSOCIATIONS, CONSTRUCTION COMPANIES in the 28 Member States, SUCH AS:

1. Bam
2. BSI
3. Bsint
4. Cece Aisbl
5. Cpe
6. Cstb
7. Cstc (BBRI)
8. CU/BRE
9. Ebc
10. Ectp
11. Efca
12. Fiec
13. Indra
14. LIST
15. Ljubljana University
16. NTNU
17. Tecnalia
18. TNO

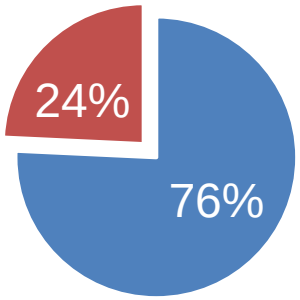
OUTPUT:

Report a list of needs and requirements of construction companies to be satisfied and to be taken into account for the definition of ontologies and the development of the BIM management system.

Definition of construction companies' needs and requirements in renovation interventions

Essential information for BIM-based renovation processes

Percentage of enterprises that define specific information for renovation processes vs percentage of enterprises that do not define any

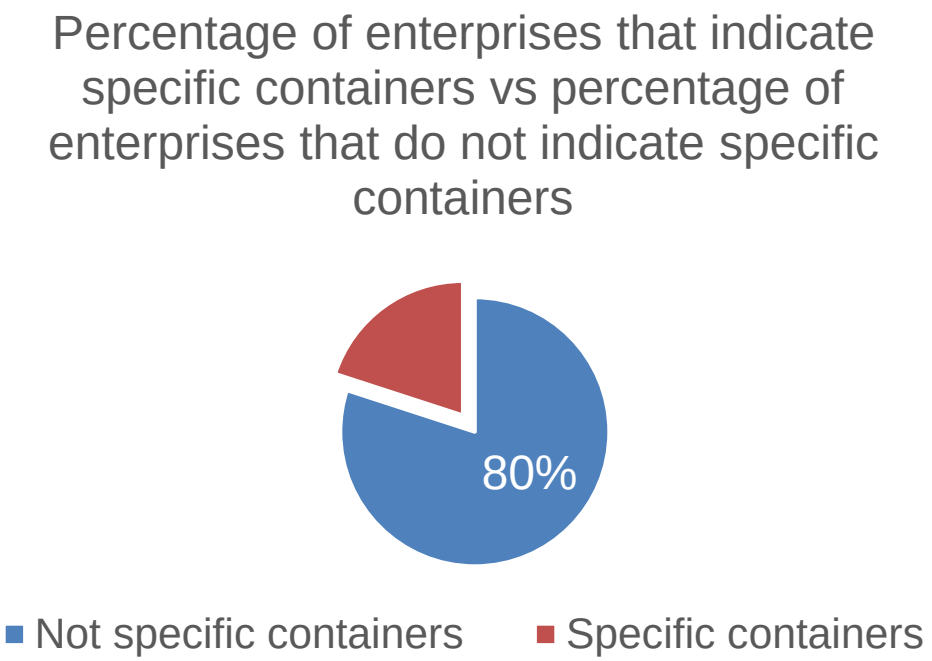


List of specific essential information

- Location
- Function
- Shape
- Material
- Cost
- Element ID
- Interdependencies with other elements
- Safety ratings
- Performance
- Installation date
- Estimated life expectancy
- Current capacity/utilization
- Warranty
- Contract documents
- Scope of the work

Definition of construction companies' needs and requirements in renovation interventions

Specific information containers for BIM-based renovation processes



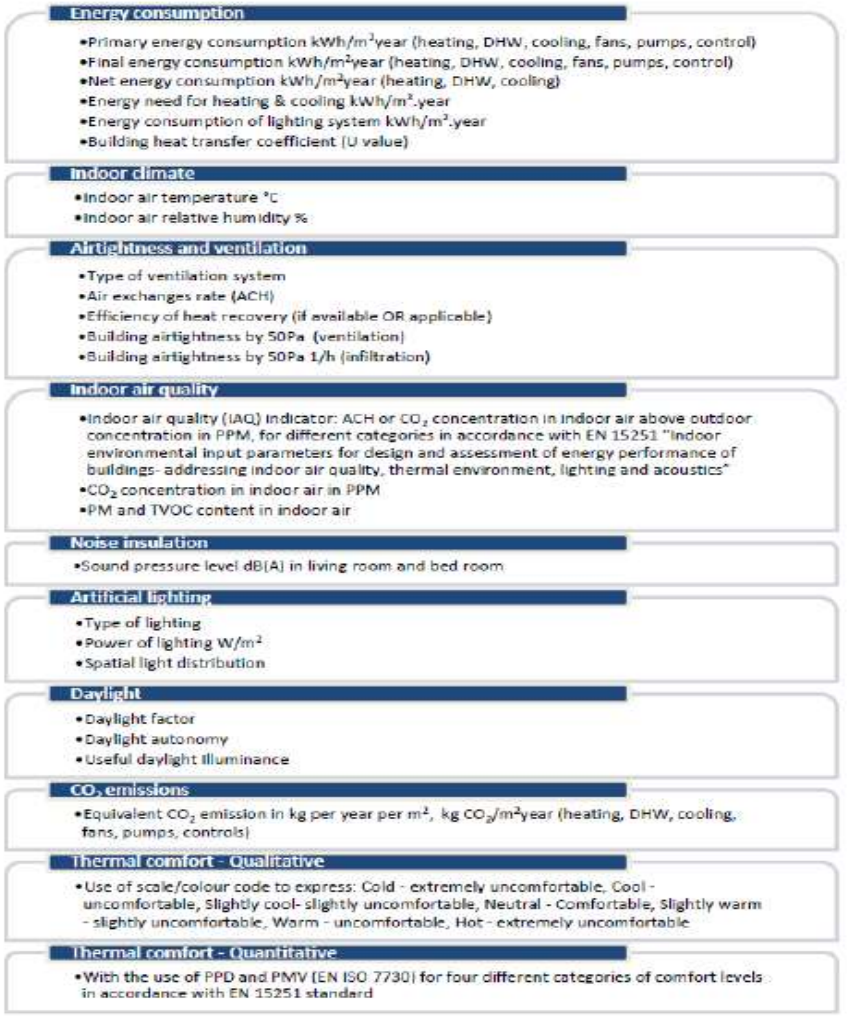
List of specific containers

- O&M manuals
- As built drawings

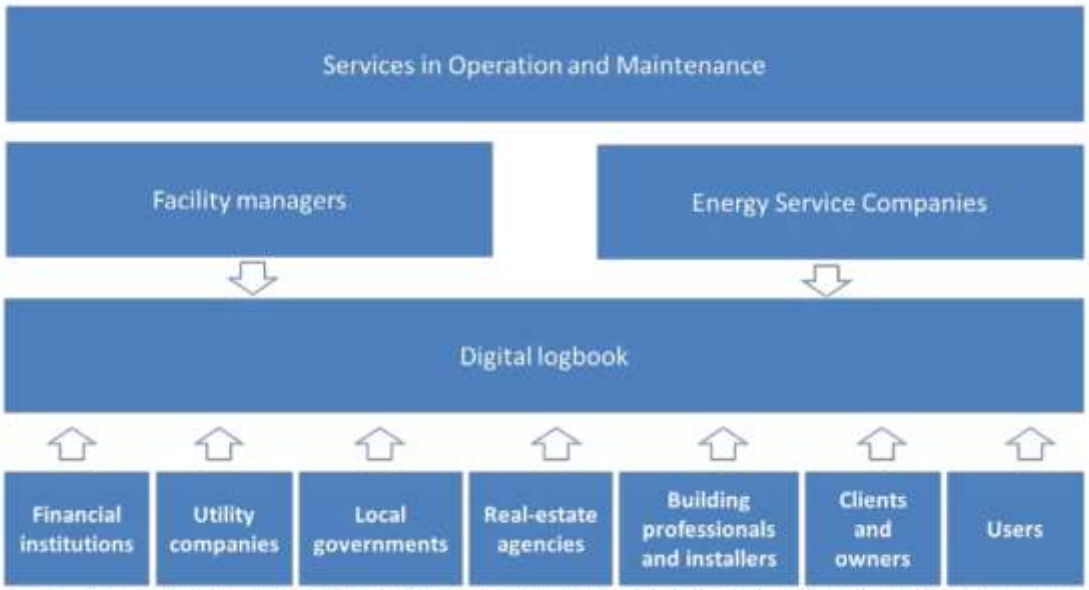
Definition of service companies' needs and requirements in renovation interventions

- Analysis of provided services by service companies, mainly with reference to Operation and Maintenance
- Literature review about existing logbooks (e.g. CIBSE, BPIE, Cornwall Council)
- Definition of information requirements related to **buildings** and **equipment/appliances** → information retrieved from drawings, O&M manuals, BMS functional information, warrantee documents

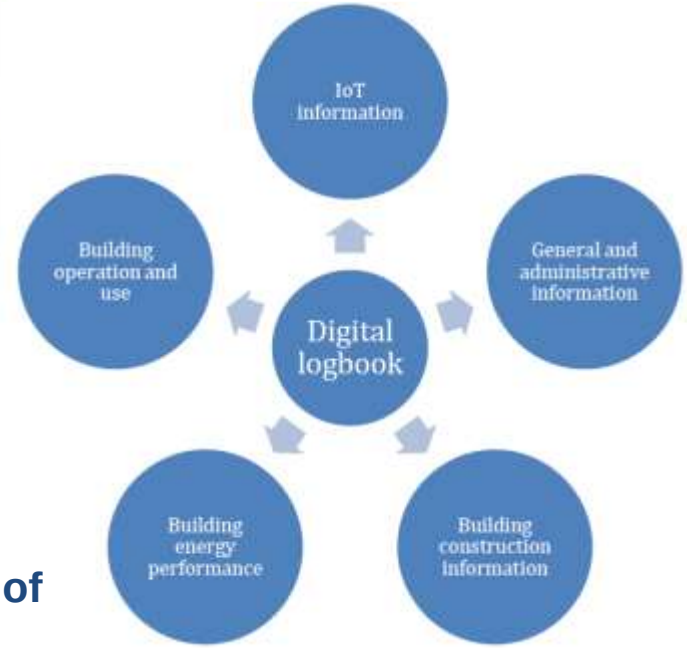
Figure 4 - List of performance indicators that could potentially be included in the Building Renovation Passport (Source: BPIE)



Definition of service companies' needs and requirements in renovation interventions

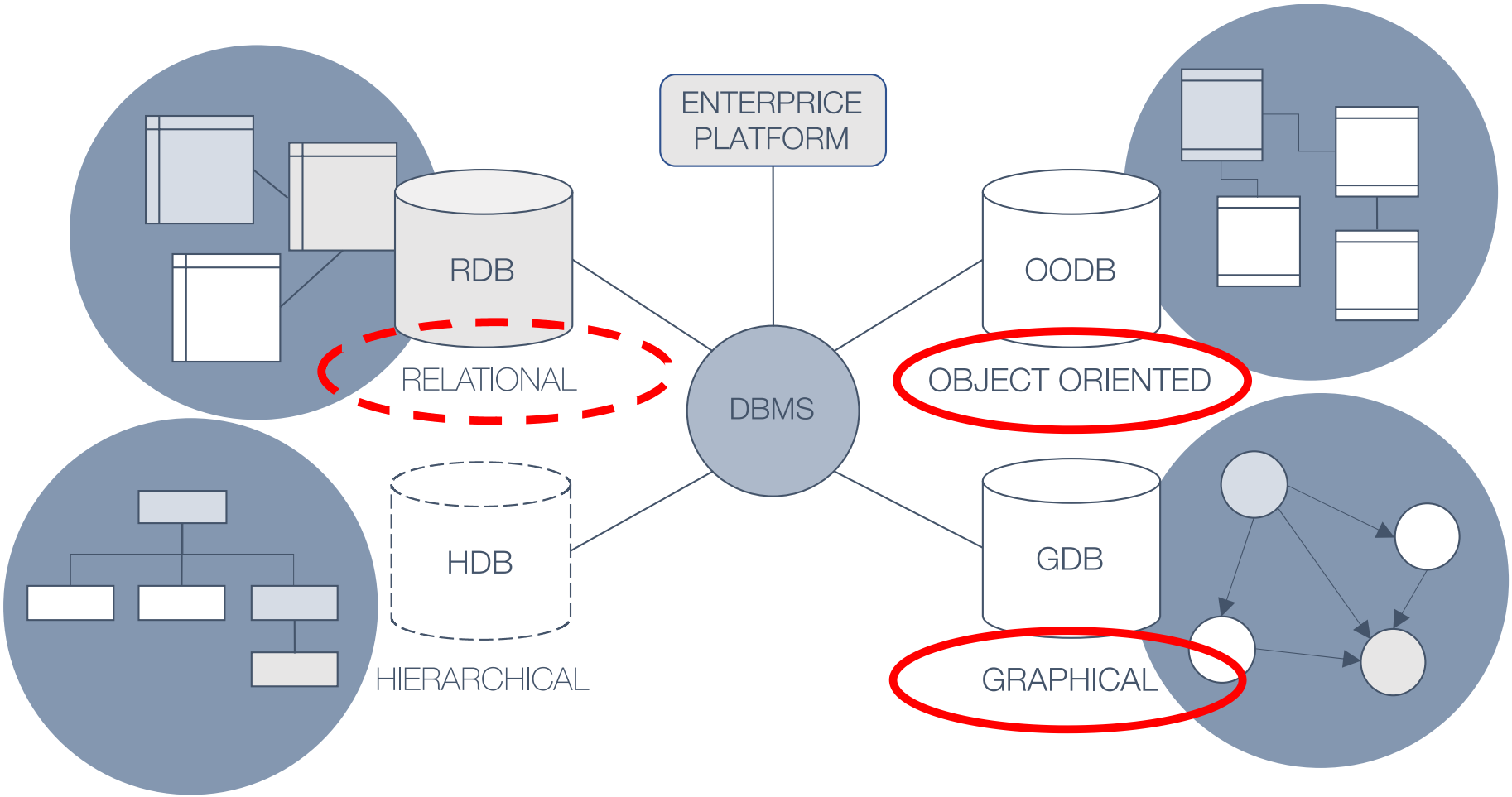


Main stakeholders considered in the definition of the information to be stored in a digital logbook



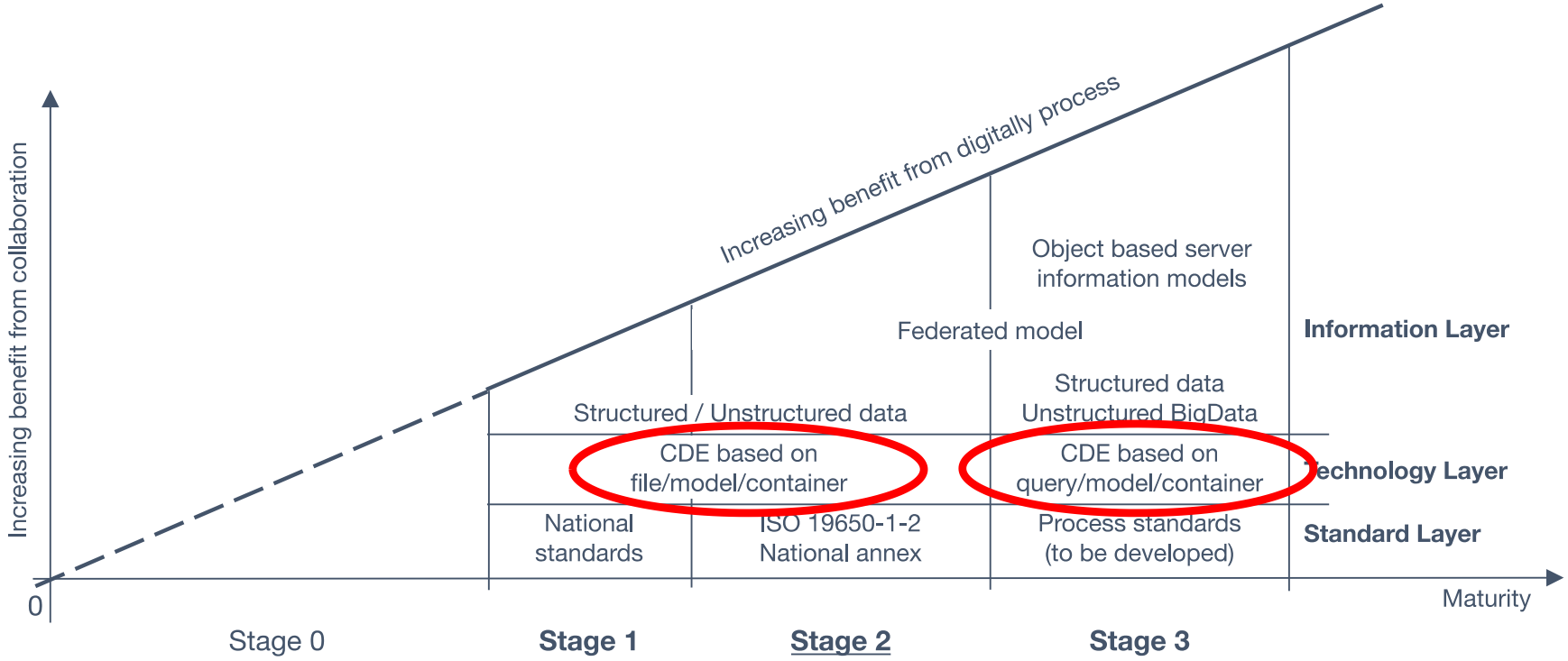
Group of information considered for the development of BIM4EEB digital logbook

New CDE to BIMMS architecture



EN ISO 19650-1:2019 - CDE

CDE	«common data environment: agreed source of *information* for any given project or *asset*, for collecting, managing and disseminating each *information container* through a managed process»



The BIM4EEB toolkit

Fast Mapping of Buildings

BIMPlanner

BIM4Occupants

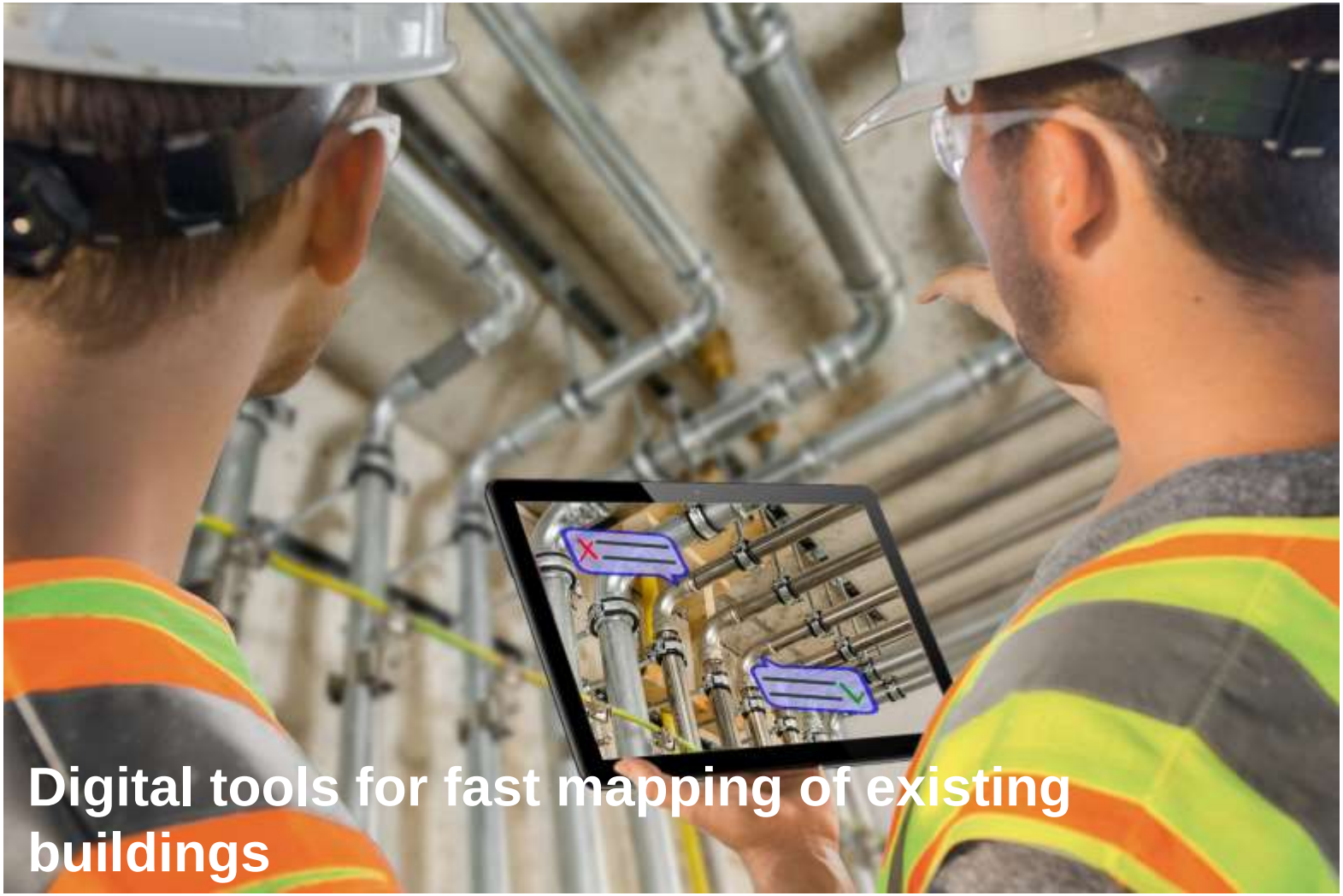
BIMMS
BIM Management System

BIMeaser

Auteras

BIMcpd

The BIM Tools



BIM4EEB

The BIM Tools

The BIM Tools

BIM4EEB

3 demonstration projects in IT, FI, PL

The Italian pilot in Monza

The Polish pilot in Chorzow

The Finnish pilot in Tampere

Any questions?

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The BIM Management System: an open Common Data Environment using Linked Data to support the efficient renovation in buildings

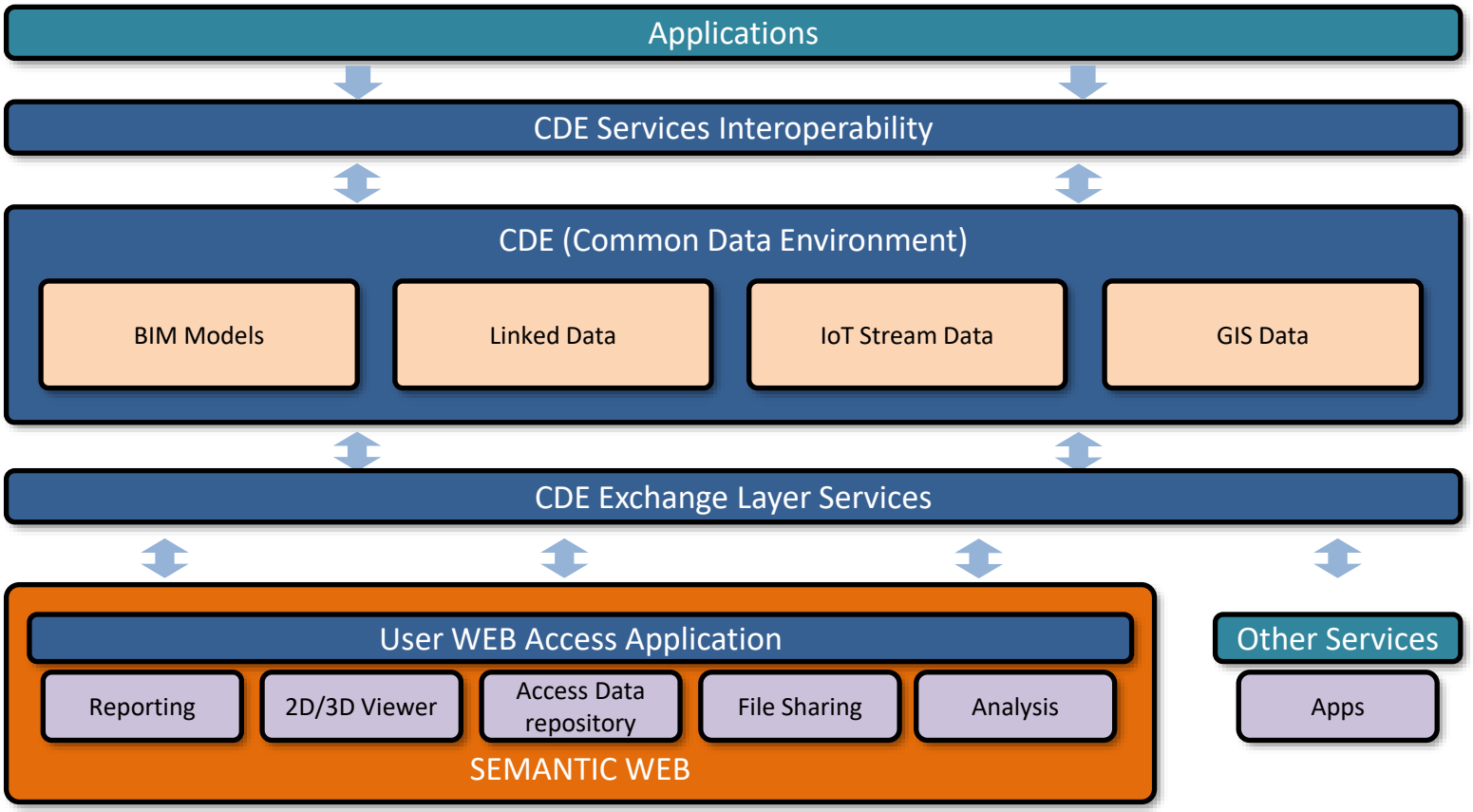
Alessandro Valra, Davide Madeddu (OneTeam)

The BIM Management System: an open Common Data Environment using Linked Data to support the efficient renovation in buildings

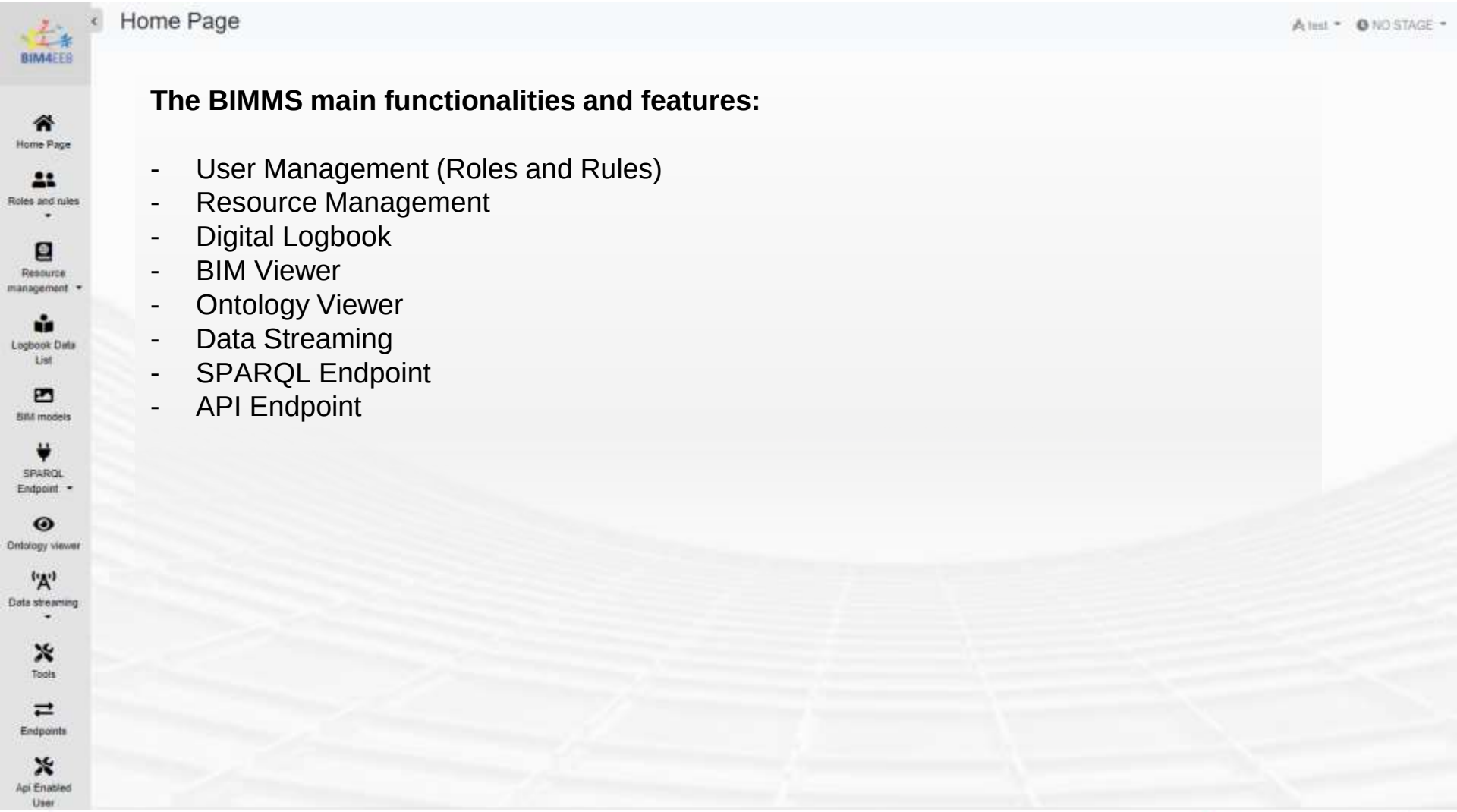
The BIM Management System (BIMMS) is a platform built around a Common Data Environment (CDE) that store all the data and information gathered through different sources and along the whole building life-cycle, acting a single source of truth (SSOT).

The BIMMS and its CDE allows to collaborate and to store, share and visualise BIM and GIS (Geographic Information System) models, manage documents, energy performance data and link the data-streaming from sensors devices to the models to evaluate the comfort preferences of inhabitants.

The BIM Management System: an open Common Data Environment using Linked Data to support the efficient renovation in buildings



The BIM Management System: an open Common Data Environment using Linked Data to support the efficient renovation in buildings

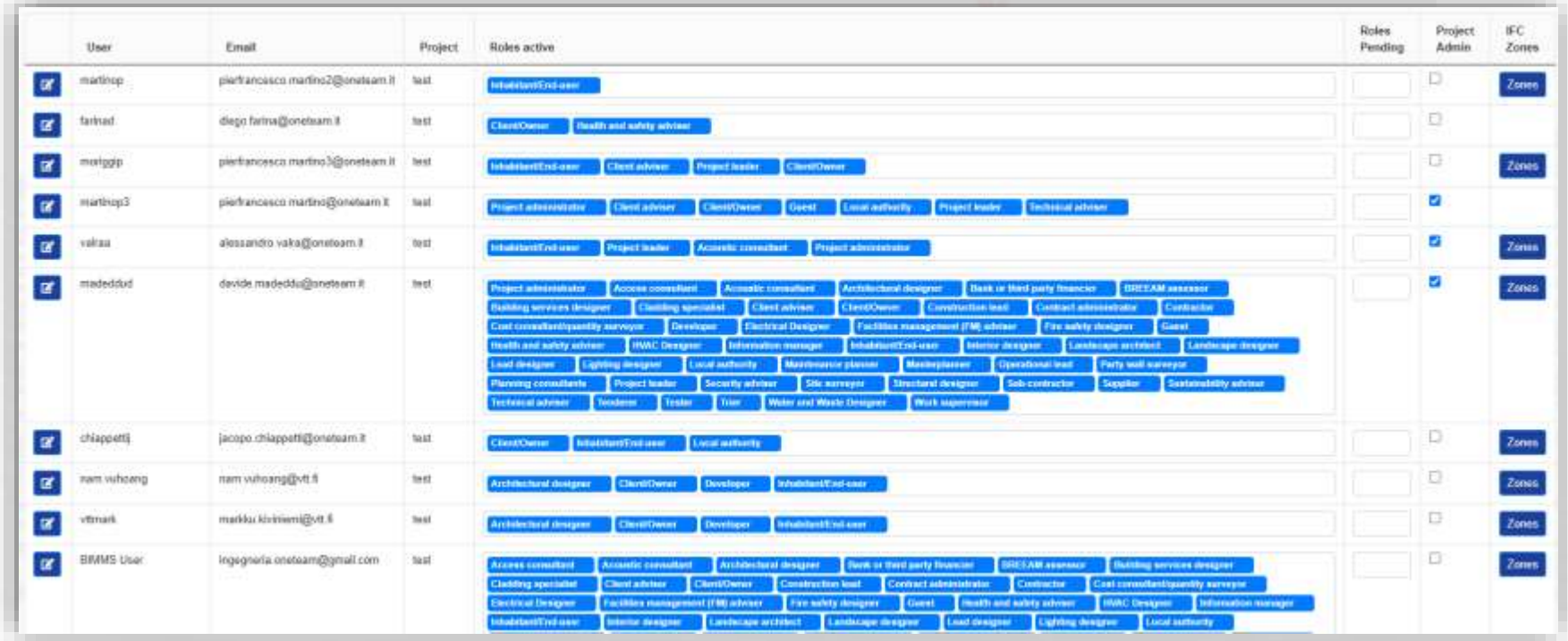


The BIMMS main functionalities and features:

- User Management (Roles and Rules)
- Resource Management
- Digital Logbook
- BIM Viewer
- Ontology Viewer
- Data Streaming
- SPARQL Endpoint
- API Endpoint

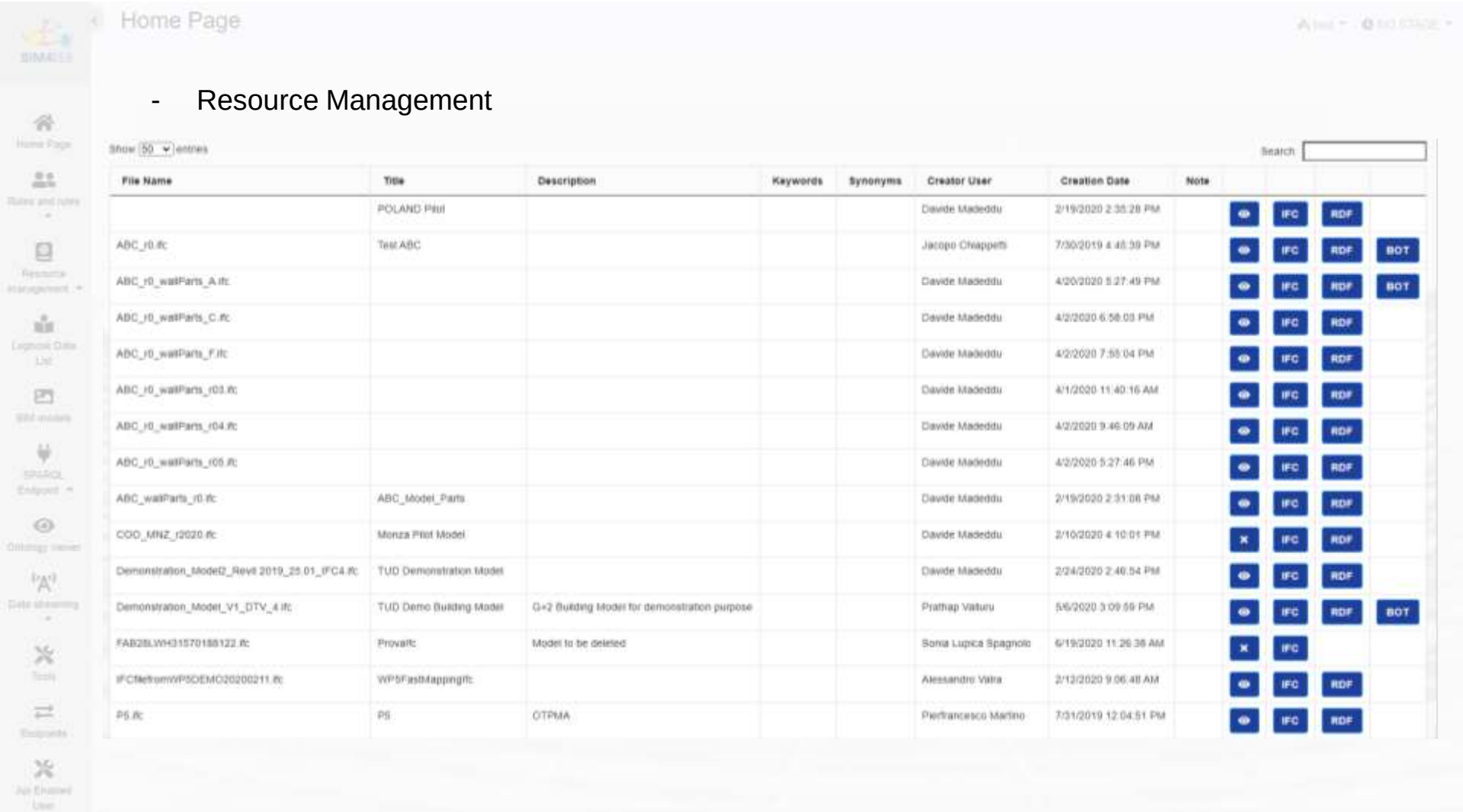
The BIM Management System: an open Common Data Environment using Linked Data to support the efficient renovation in buildings

- User Management (Roles and Rules)



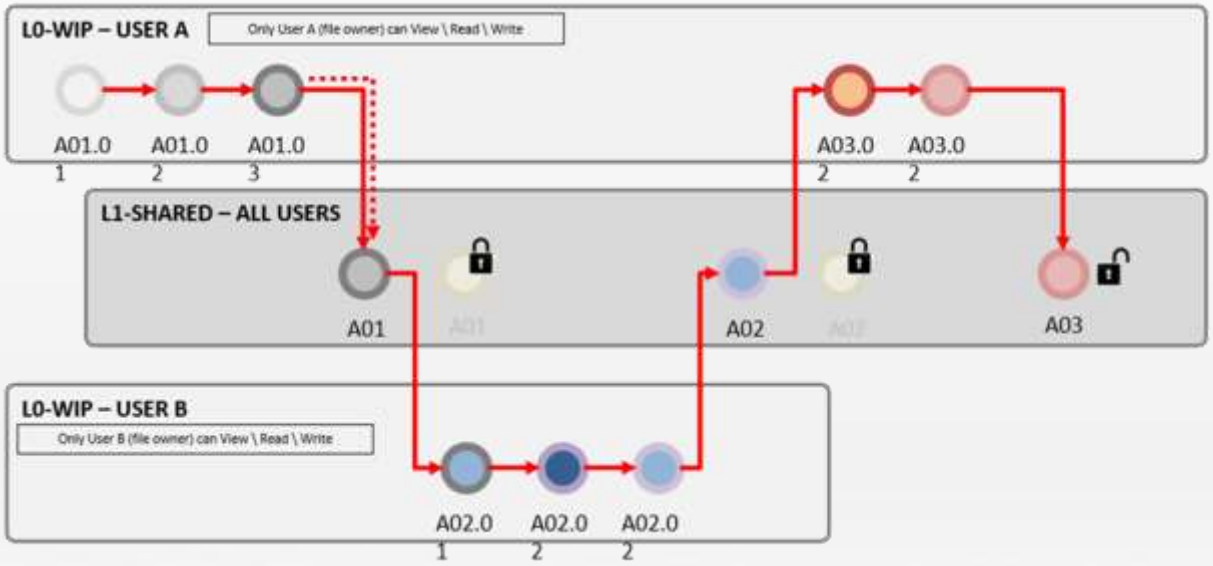
The BIM Management System: an open Common Data Environment using Linked Data to support the efficient renovation in buildings

- Resource Management



The BIM Management System: an open Common Data Environment using Linked Data to support the efficient renovation in buildings

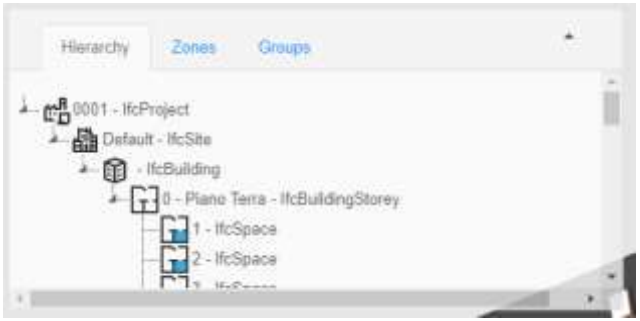
- Resource Management

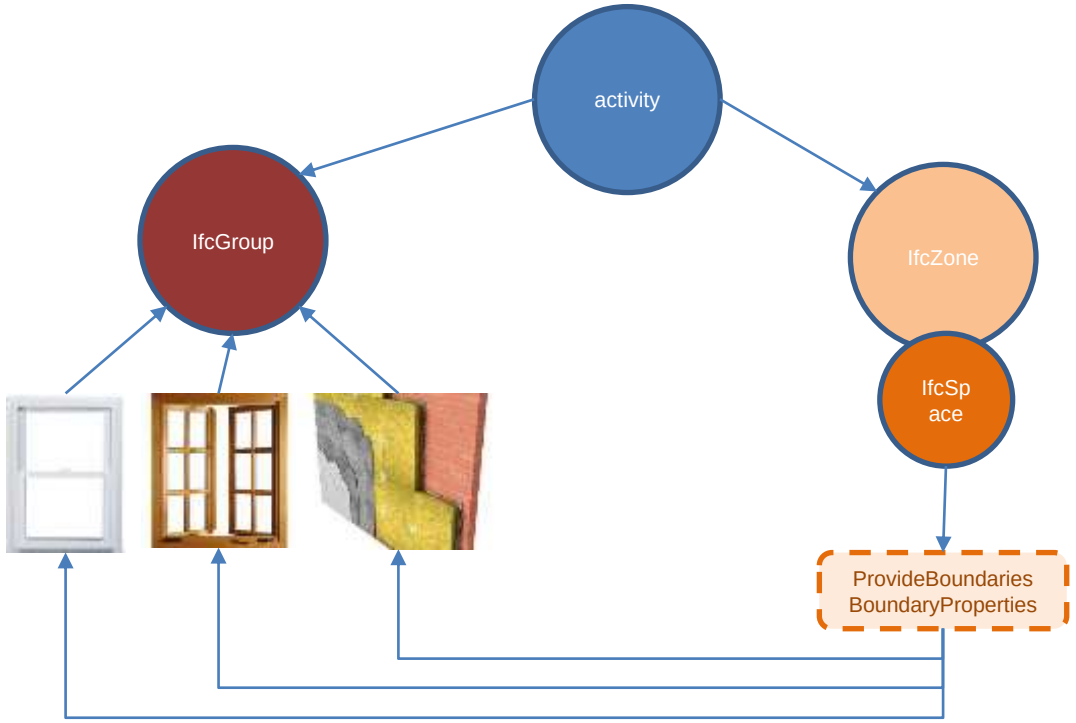


The BIM Management System: an open Common Data Environment using Linked Data to support the efficient renovation in buildings

- BIM Viewer

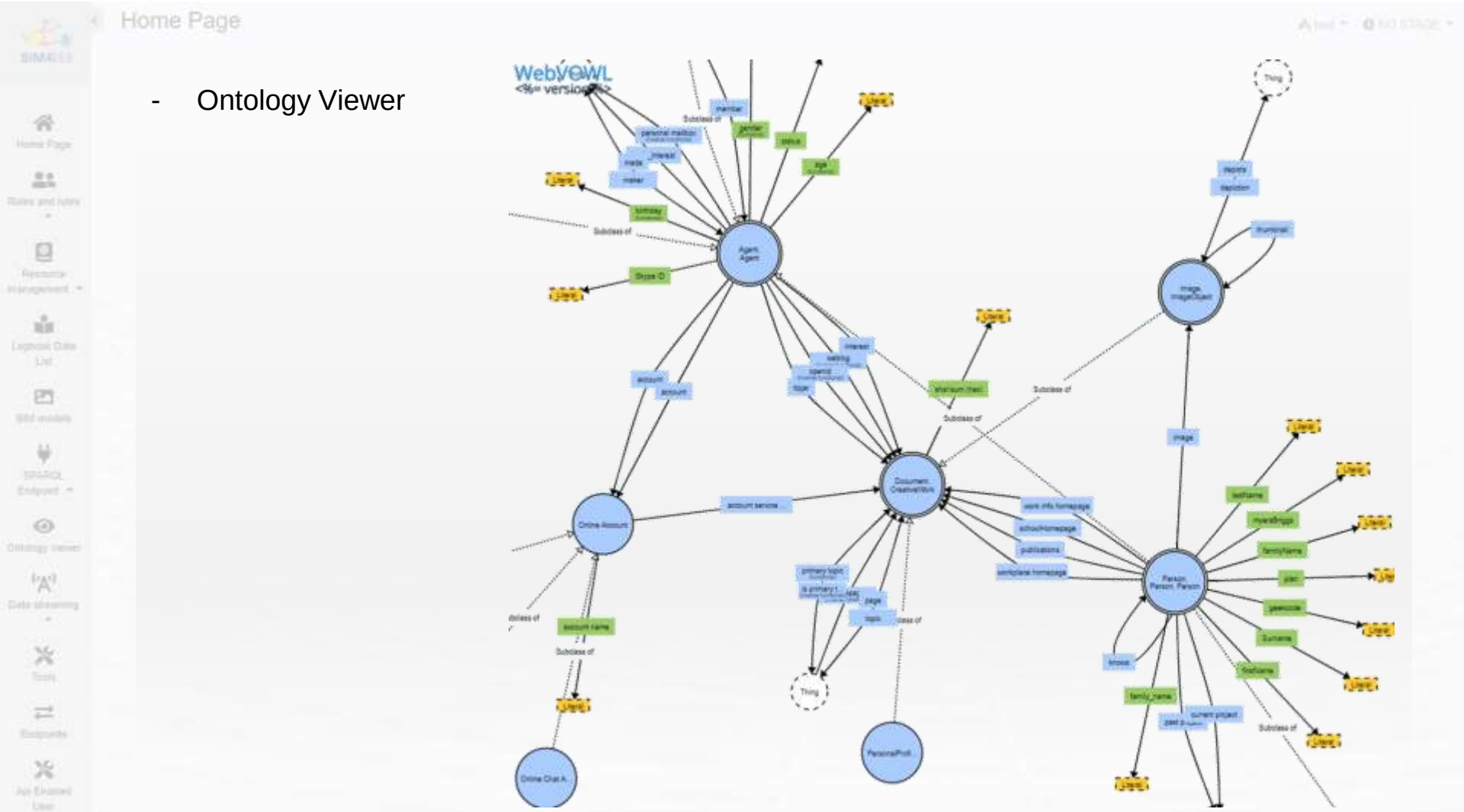
The BIM Management System: an open Common Data Environment using Linked Data to support the efficient renovation in buildings





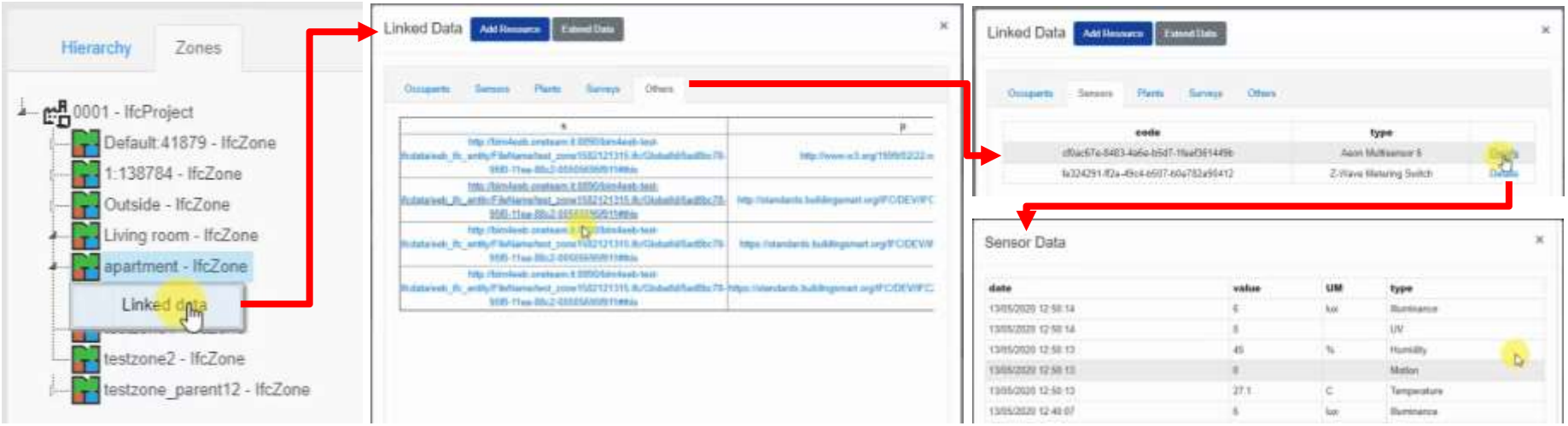
The BIM Management System: an open Common Data Environment using Linked Data to support the efficient renovation in buildings

- Ontology Viewer



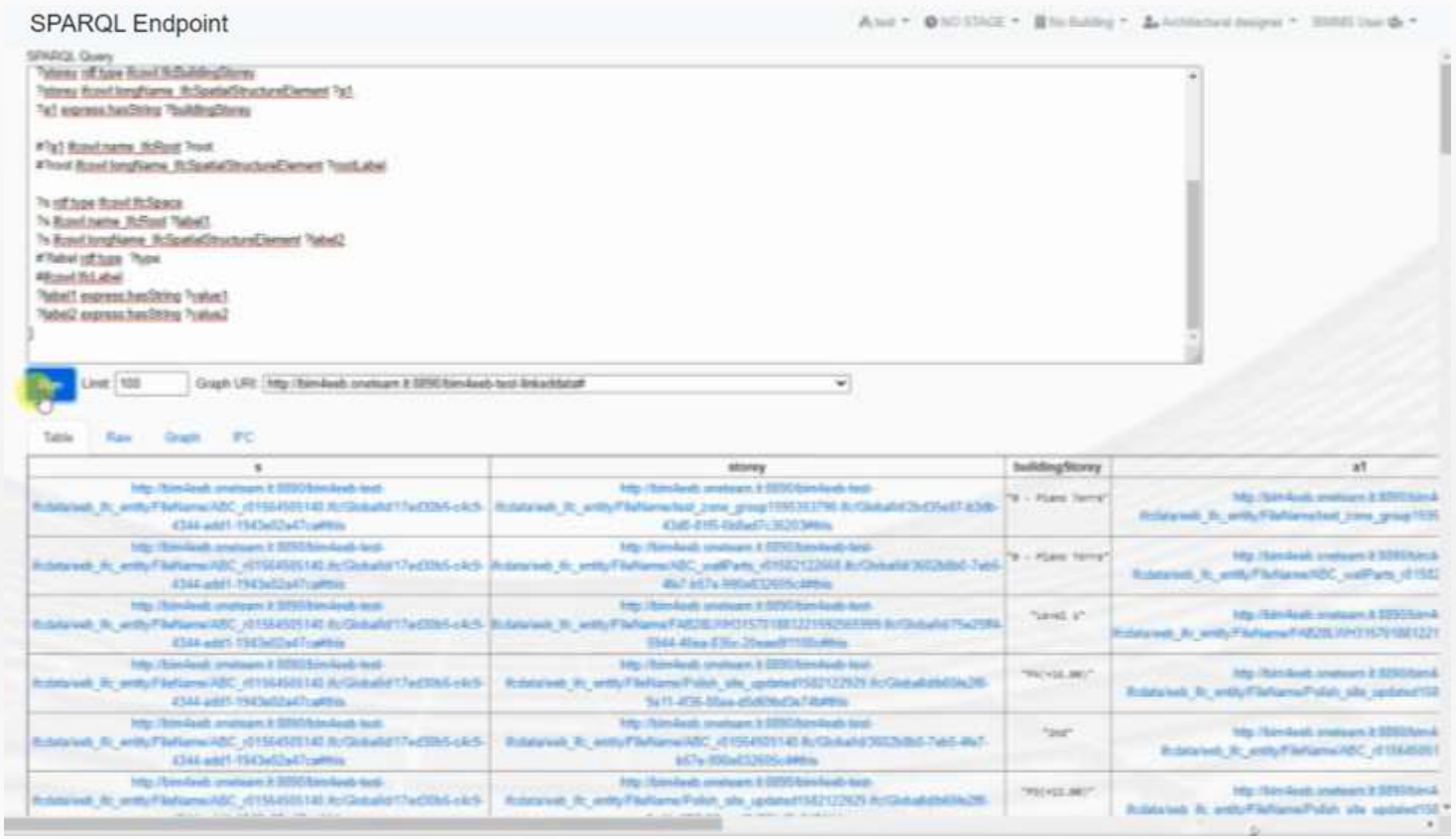
The BIM Management System: an open Common Data Environment using Linked Data to support the efficient renovation in buildings

- Data streaming



The BIM Management System: an open Common Data Environment using Linked Data to support the efficient renovation in buildings

- SPARQL Endpoint

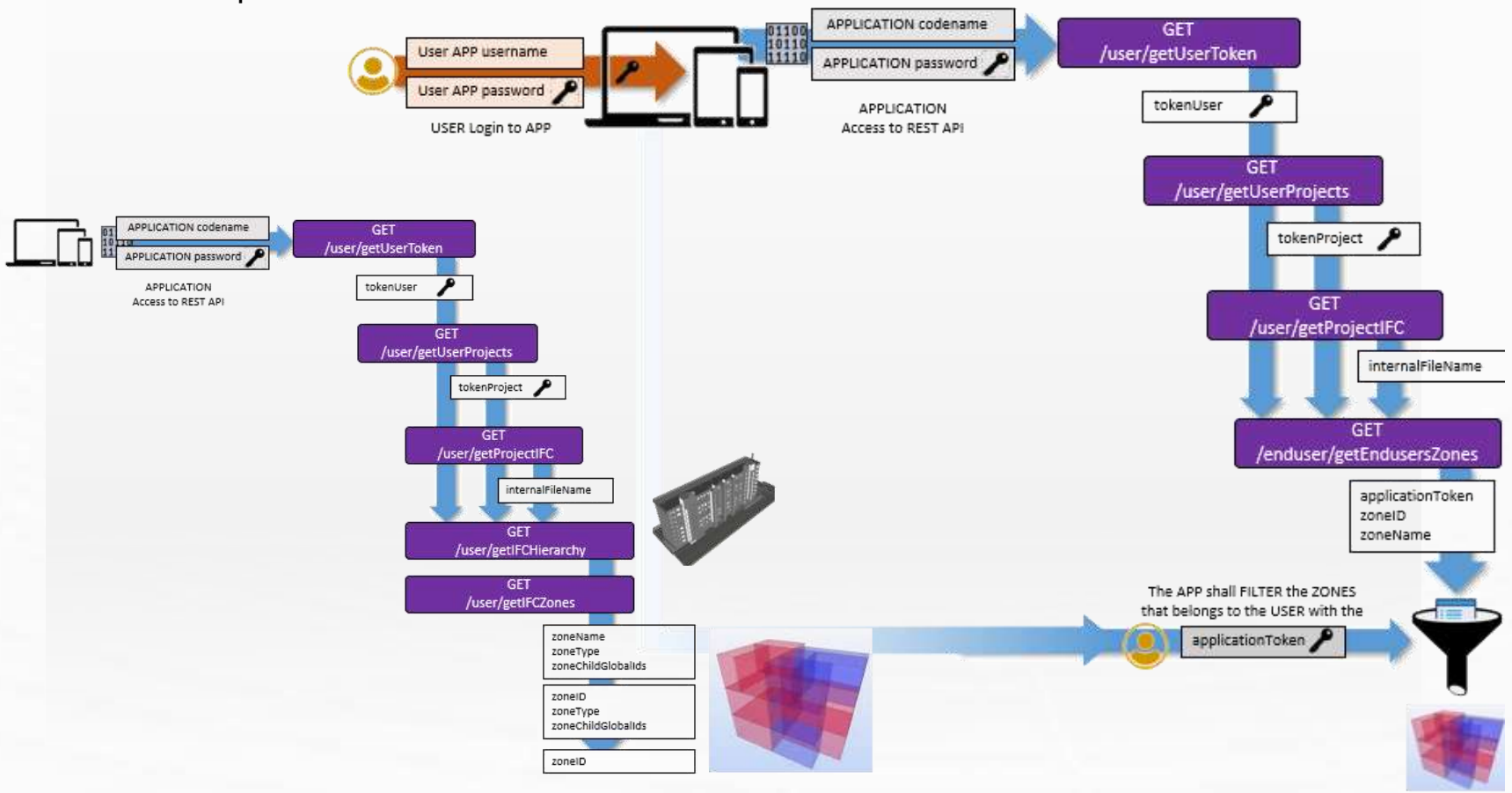


The BIM Management System: an open Common Data Environment using Linked Data to support the efficient renovation in buildings

- API Endpoint

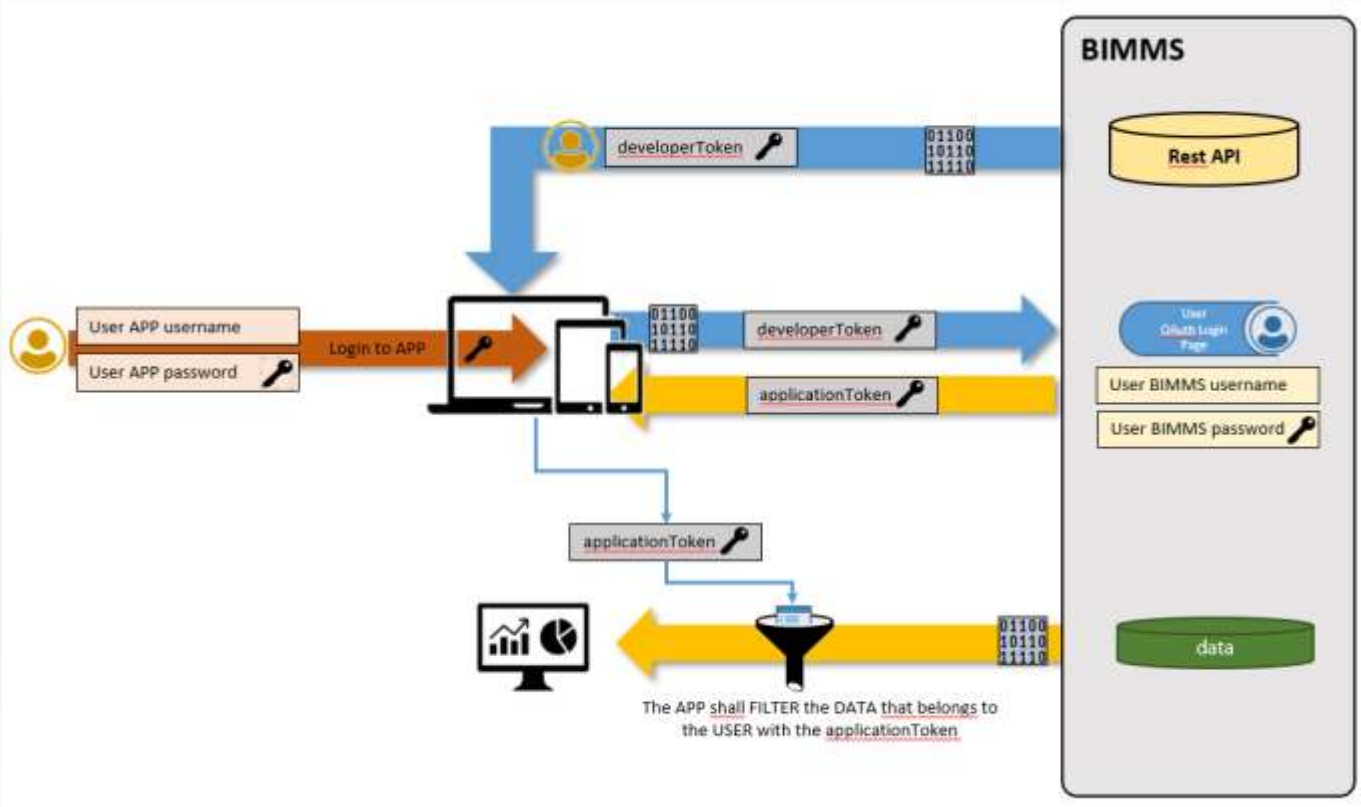
The BIM Management System: an open Common Data Environment using Linked Data to support the efficient renovation in buildings

- API Endpoint



The BIM Management System: an open Common Data Environment using Linked Data to support the efficient renovation in buildings

- Privacy and Pseudonymization



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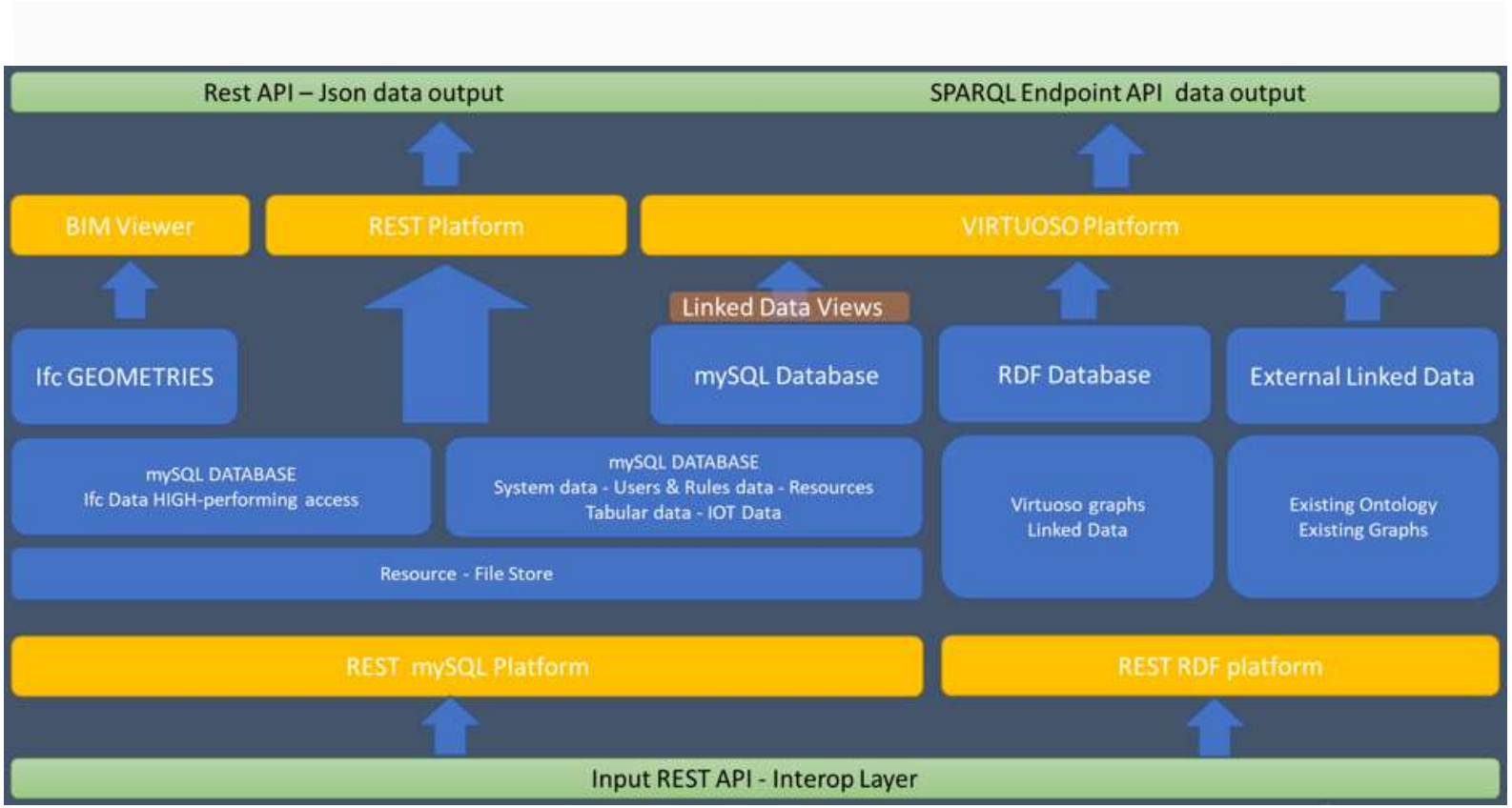

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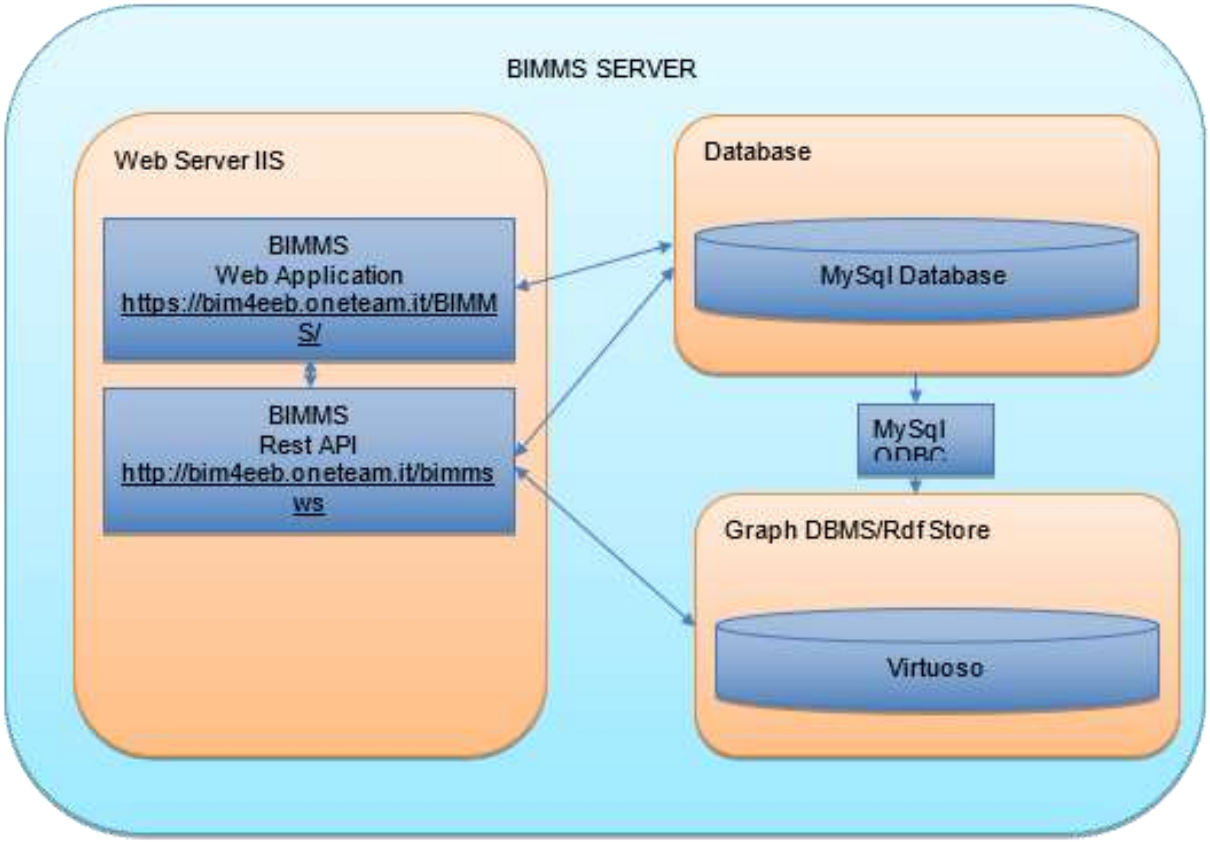

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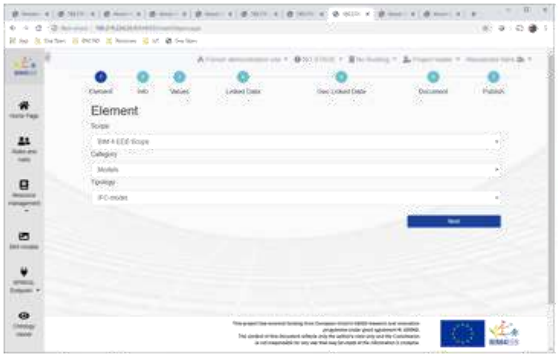
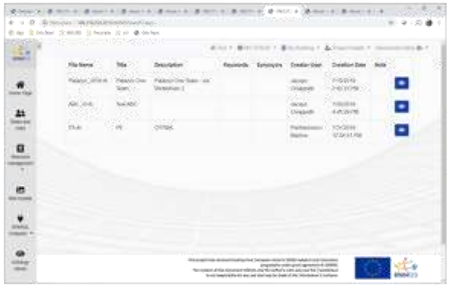


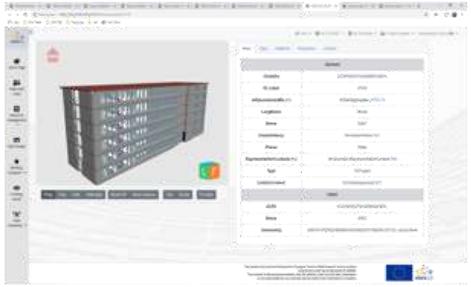
BIM4EEB IFC engine
Model parsing
MySQL DB storage

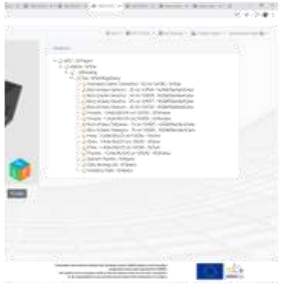
1 Log In

2 Create new resource
Upload BIM Ifc Model

3 Batch process



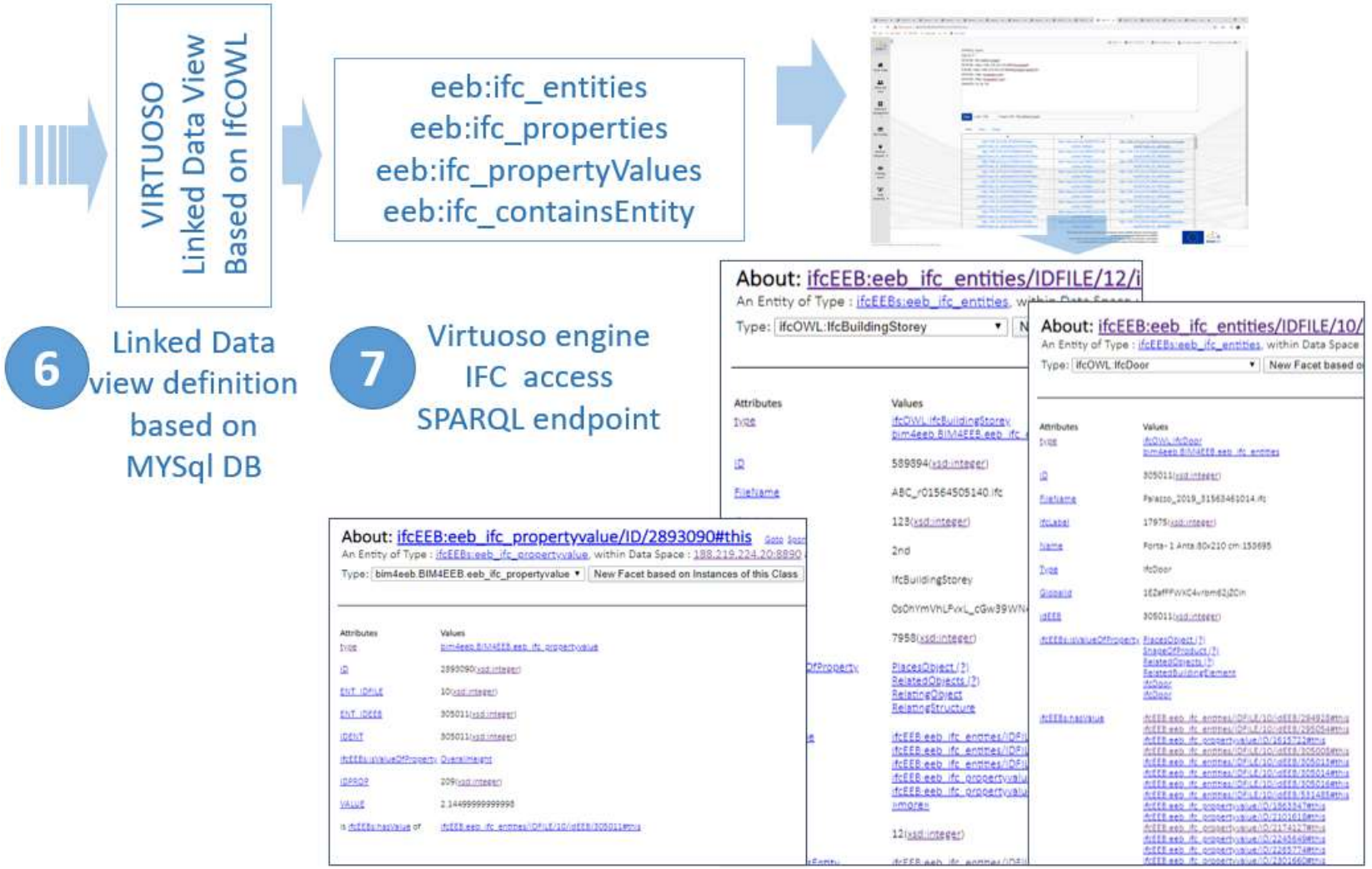




4 Processed BIM model list

5 DB Based Access to:
3D Model View
Ifc Data and structure

The BIM Management System: an open Common Data Environment using Linked Data to support the efficient renovation in buildings



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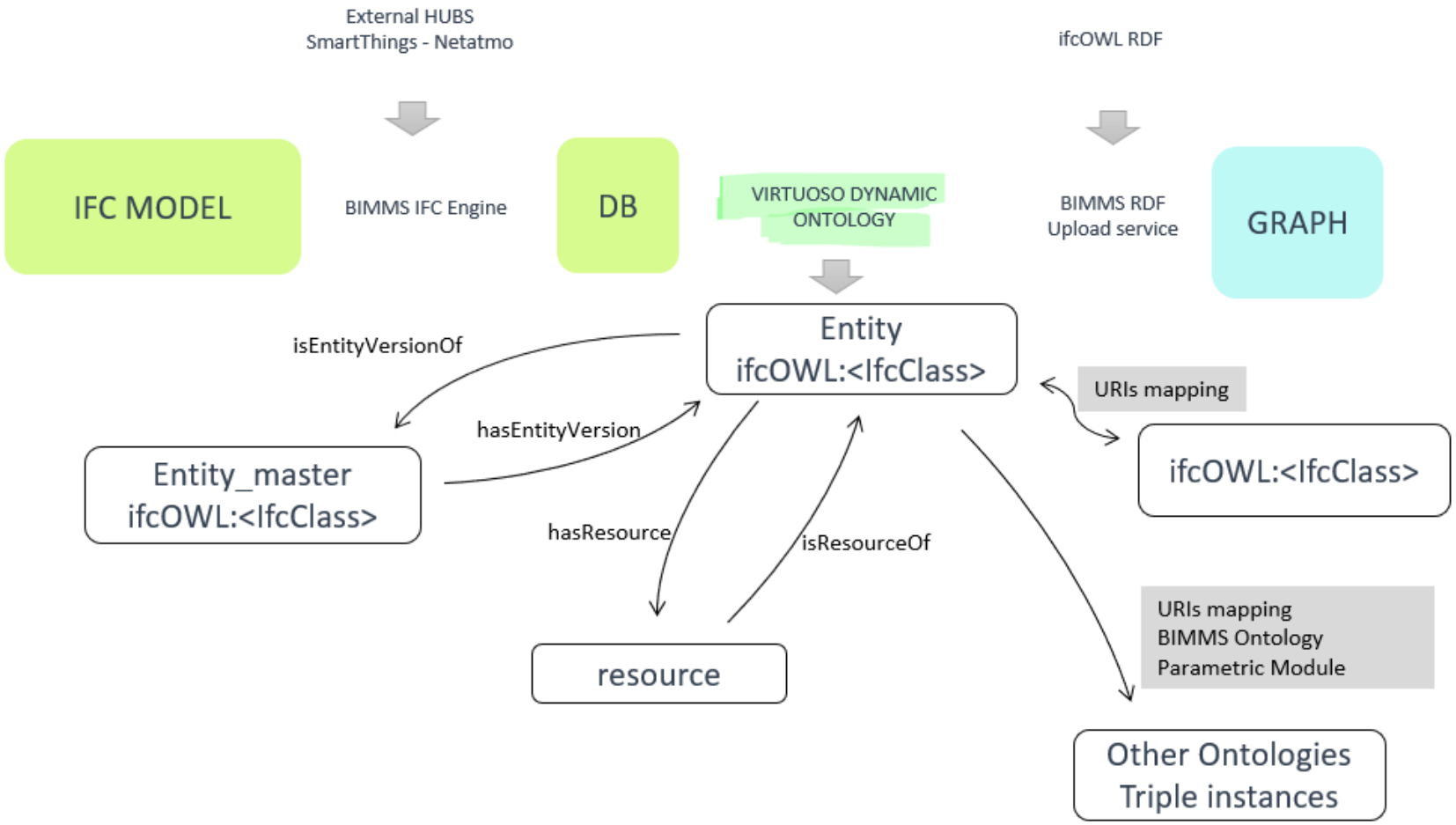

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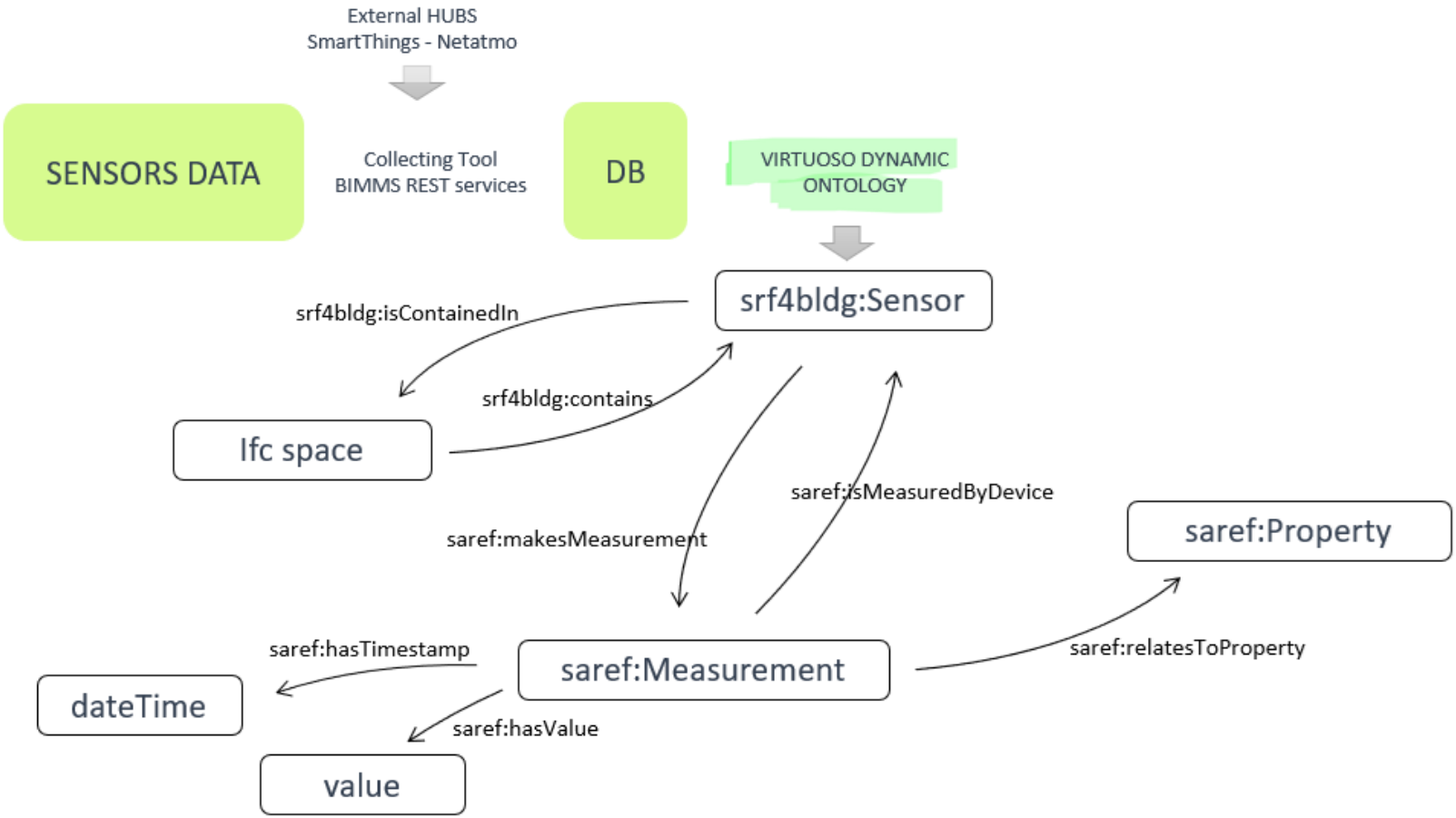

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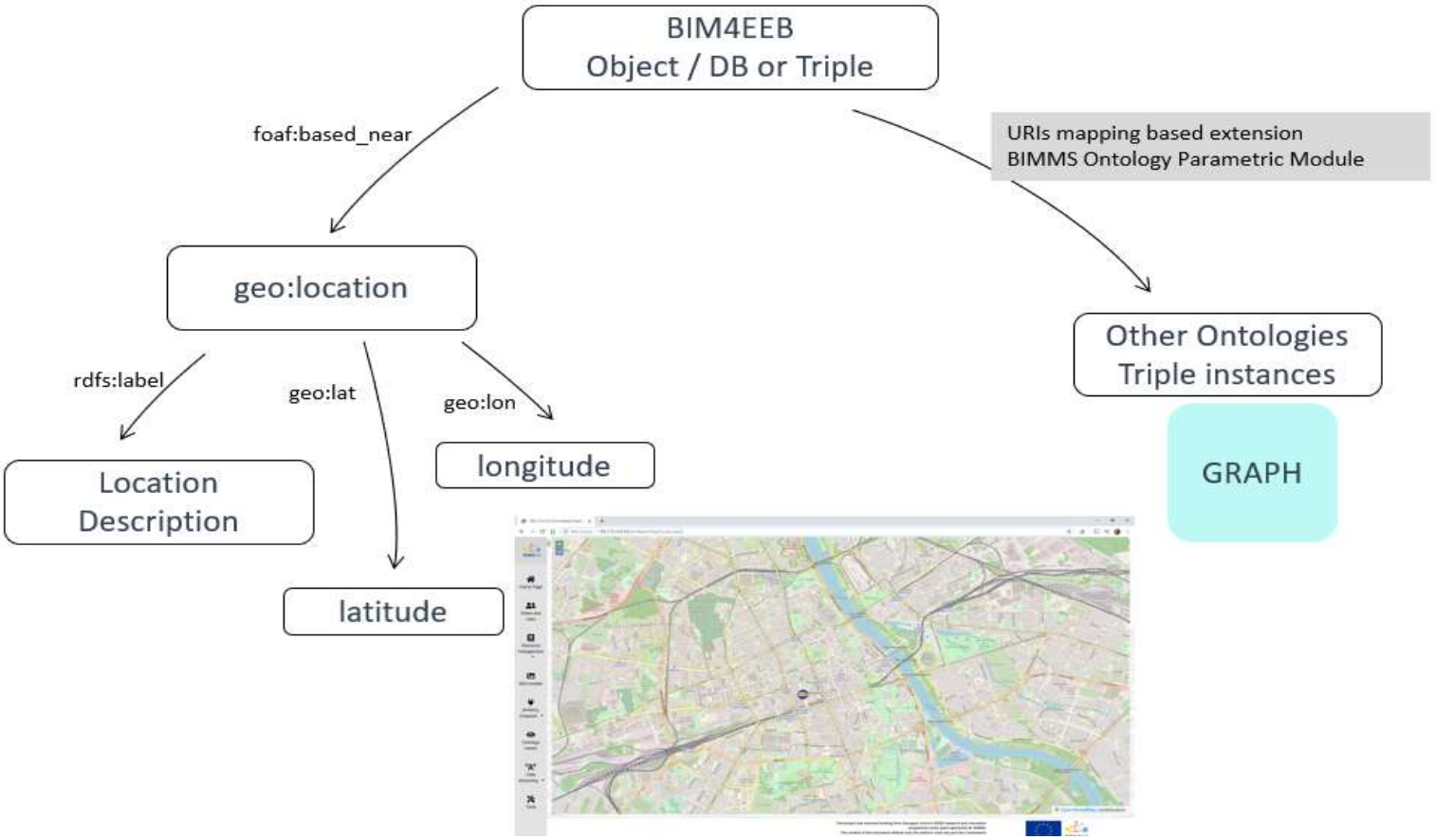

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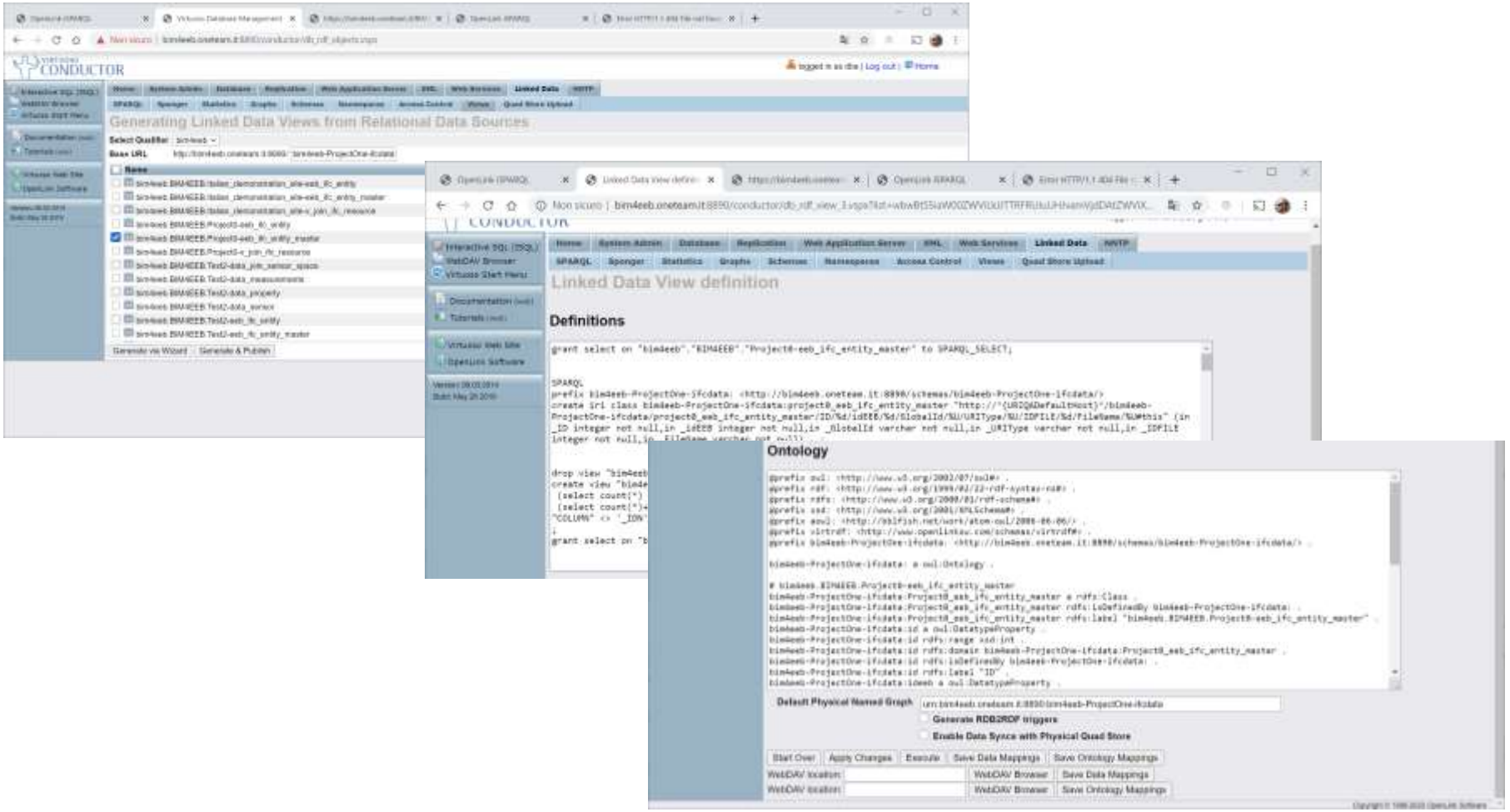


BIM Management System

Interactive Poll

Which feature should have the actual commercial CDEs to improve the collaboration?

Interactive Poll

What are the most valued BIMMS feature?

Interactive Poll

How do you rate the BIMMS?

Any questions?

Fast Mapping for Buildings AR-toolkit

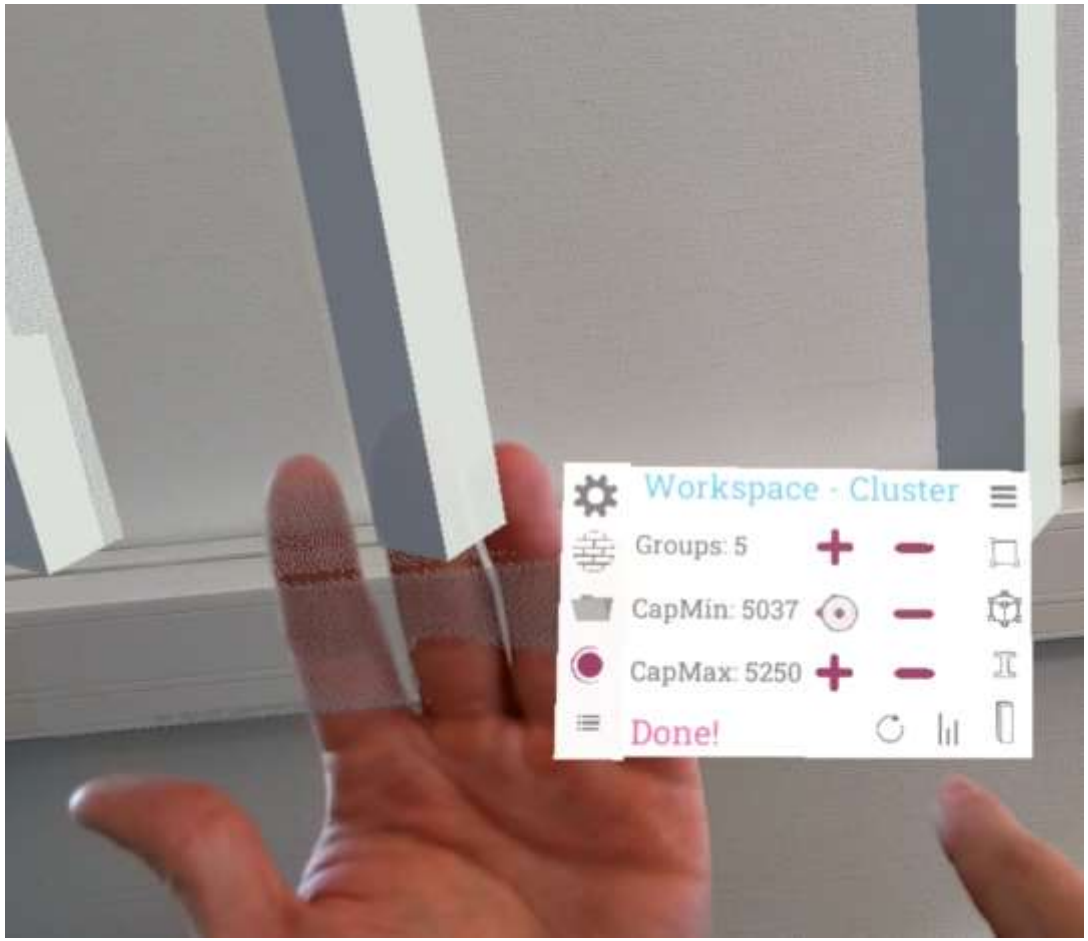
Speaker:
Birgitta Andersson (RISE)
Per Andersson (CGI)

Fast Mapping for Buildings AR-toolkit

View from AR-tool.

New drawings can be created if those are missing in a renovation building.

By using our AR-tool a 3D-view is visualized.



Fast Mapping for Buildings AR-toolkit

The Fast Mapping Toolkit aims to develop a tool for fast mapping of buildings regarding geometric parameters, heating- and waterpipes, ventilation systems, electrical cables and materials.

To cover the needs of installation schemes and drawings in renovations we develop a fast and precise tool.

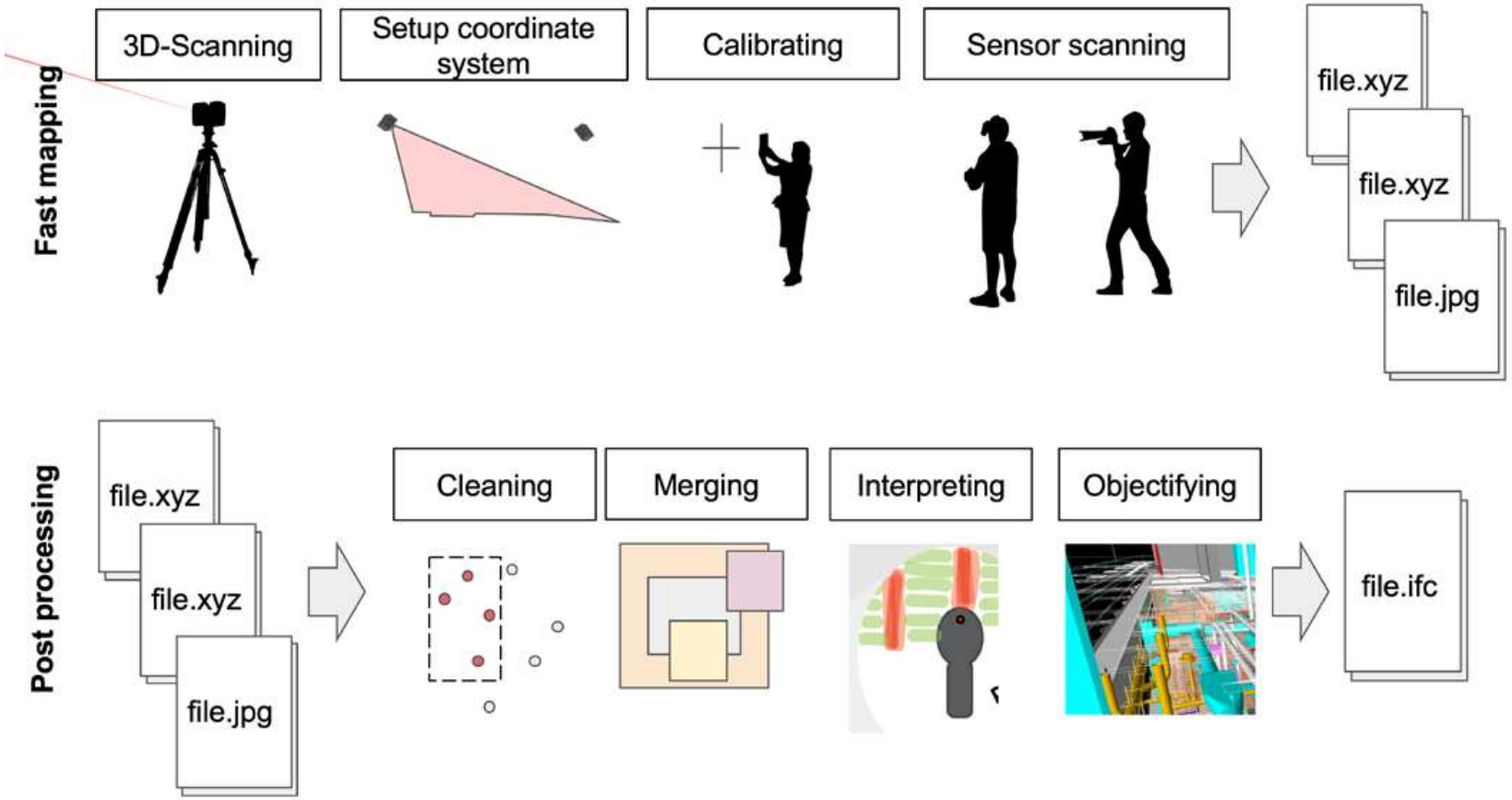
- It is a user-friendly light-weight sensorstick for mapping walls together with the scanning.
- A headset will visualize the collected data by an interface module to view installations inside walls.

Fast Mapping for Buildings AR-toolkit

The Fast Mapping Toolkit will be useful for the following target gruops:

- Renovation companies
- Architechts
- Technical designers
- Building owners
- Installation workers

Fast Mapping for Buildings AR-toolkit



Fast Mapping for Buildings AR-toolkit

Set up for mapping walls by laserscanning, sensor stick and AR-tool headset.

- The laser scanner measures the geometry of the room and transfer data into a point cloud.
- Sensor stick detects the materials and installations inside the wall
- The AR-tool visualize a 3D-map of the scanned and mapped areas.

Fast Mapping for Buildings AR-toolkit

Most important functionalities in Sensor stick are:

- Electricity sensor for finding electrical cables in walls
- Positioning function for tracking sensor stick in real time
- Temperature sensor to detect differences in temperature
- Sensors for inductivity and capacitivity to find studs and humidity inside the walls
- Metal sensor for finding magnetic materials

Fast Mapping for Buildings AR-toolkit

Scanning with sensor stick to find installations inside the wall.

Sweep the sensor stick to detect materials and electricity.

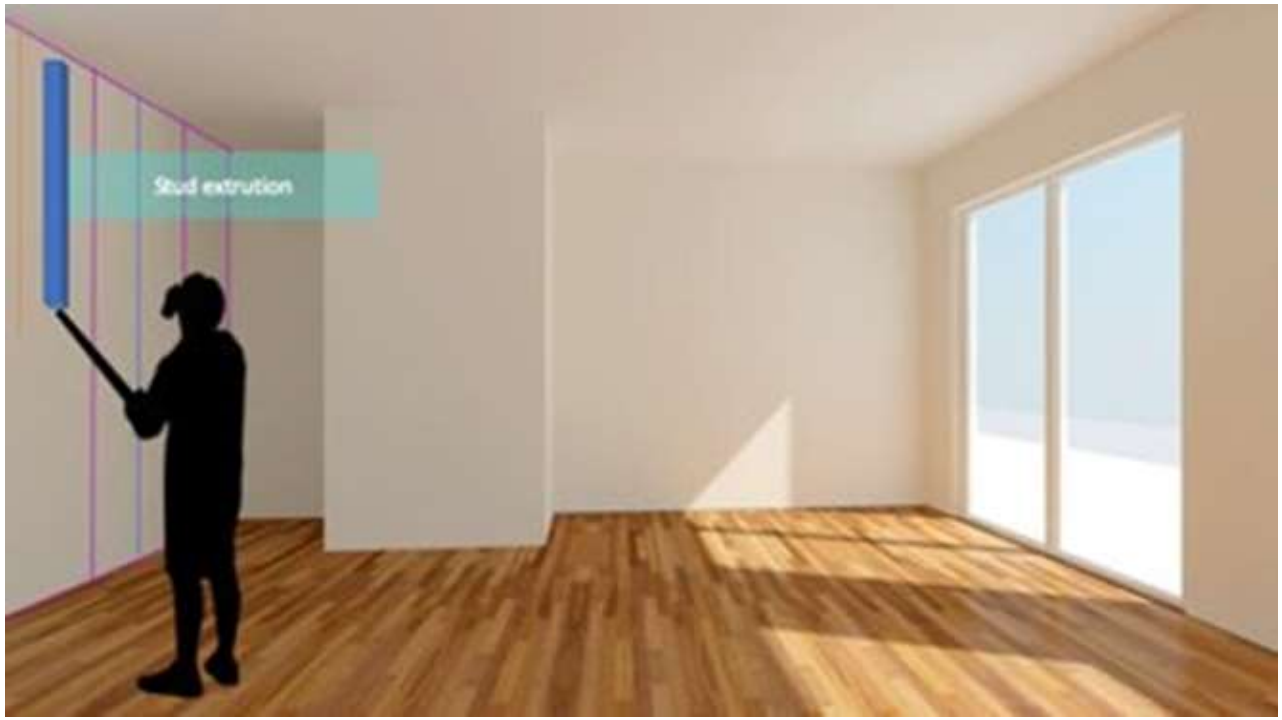
Fast Mapping for Buildings AR-toolkit

Scanning with
sensor stick
to find installations
inside
the wall

If you do not know where cables are located, this tool will help you to find them.

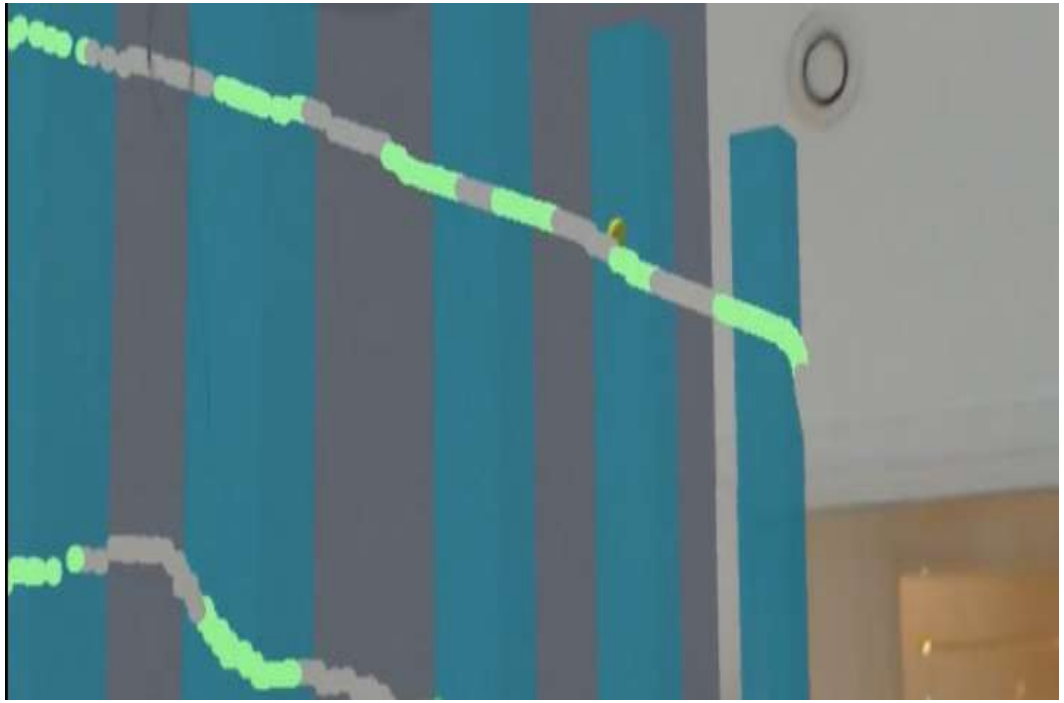
Fast Mapping for Buildings AR-toolkit

Creation of autogenerated beams by scanning with sensor stick.



Fast Mapping for Buildings AR-toolkit

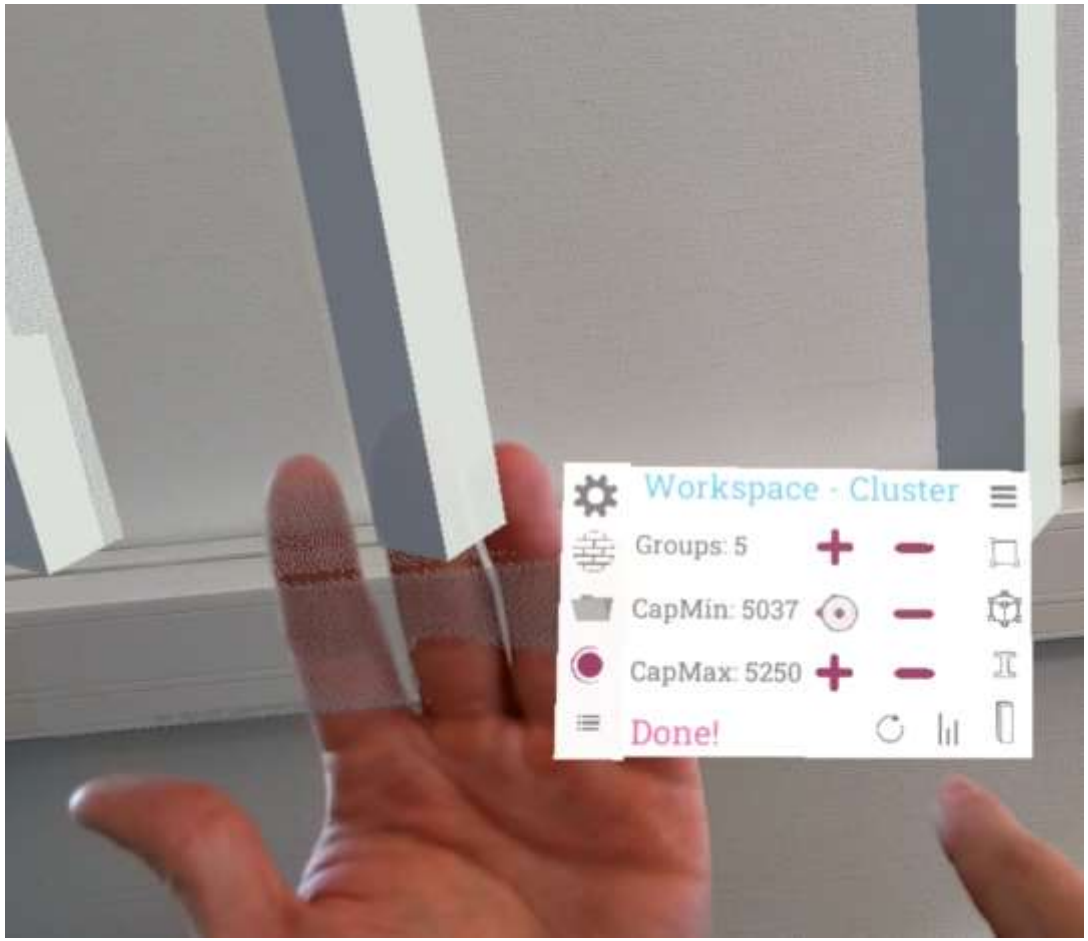
Generated studs
from AR-tool
after scanning walls.



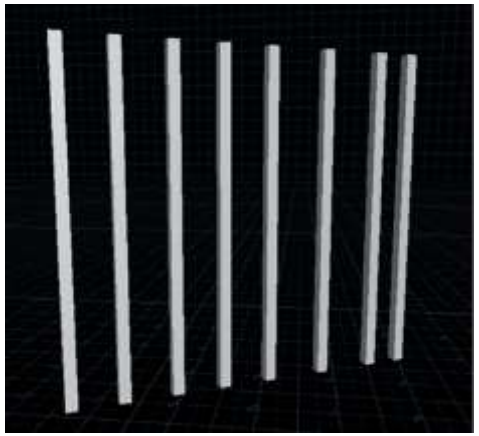
Fast Mapping for Buildings AR-toolkit

View from AR-tool.

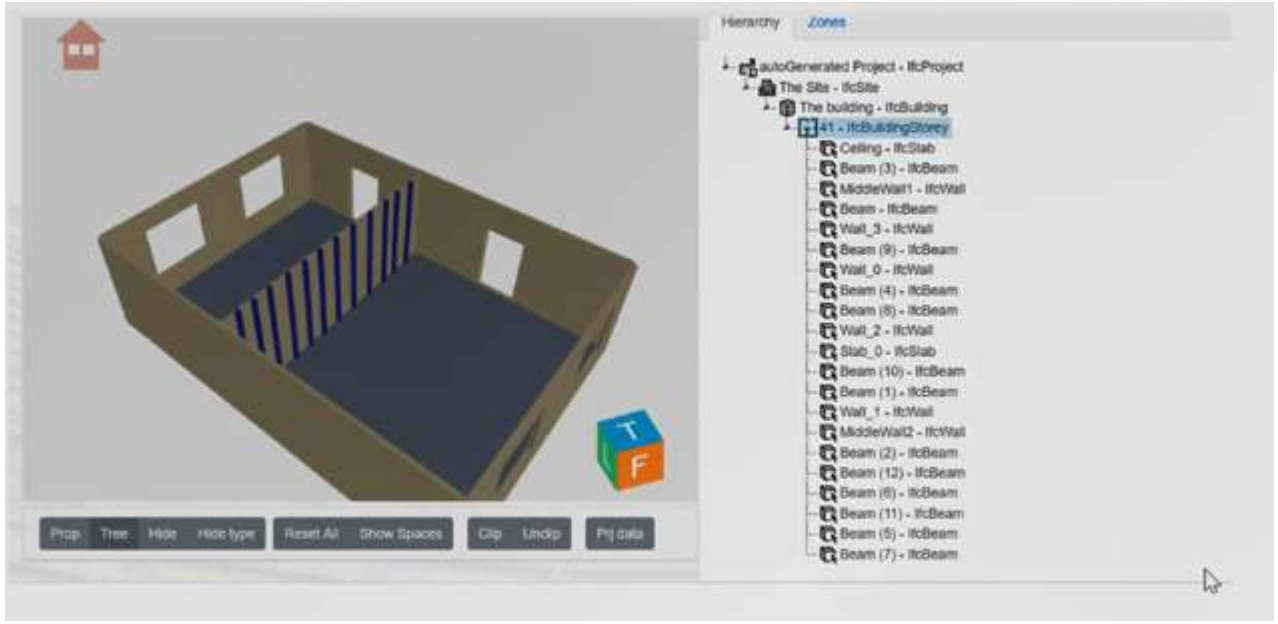
3D-map of studs from mapping with sensor stick inside a wall.



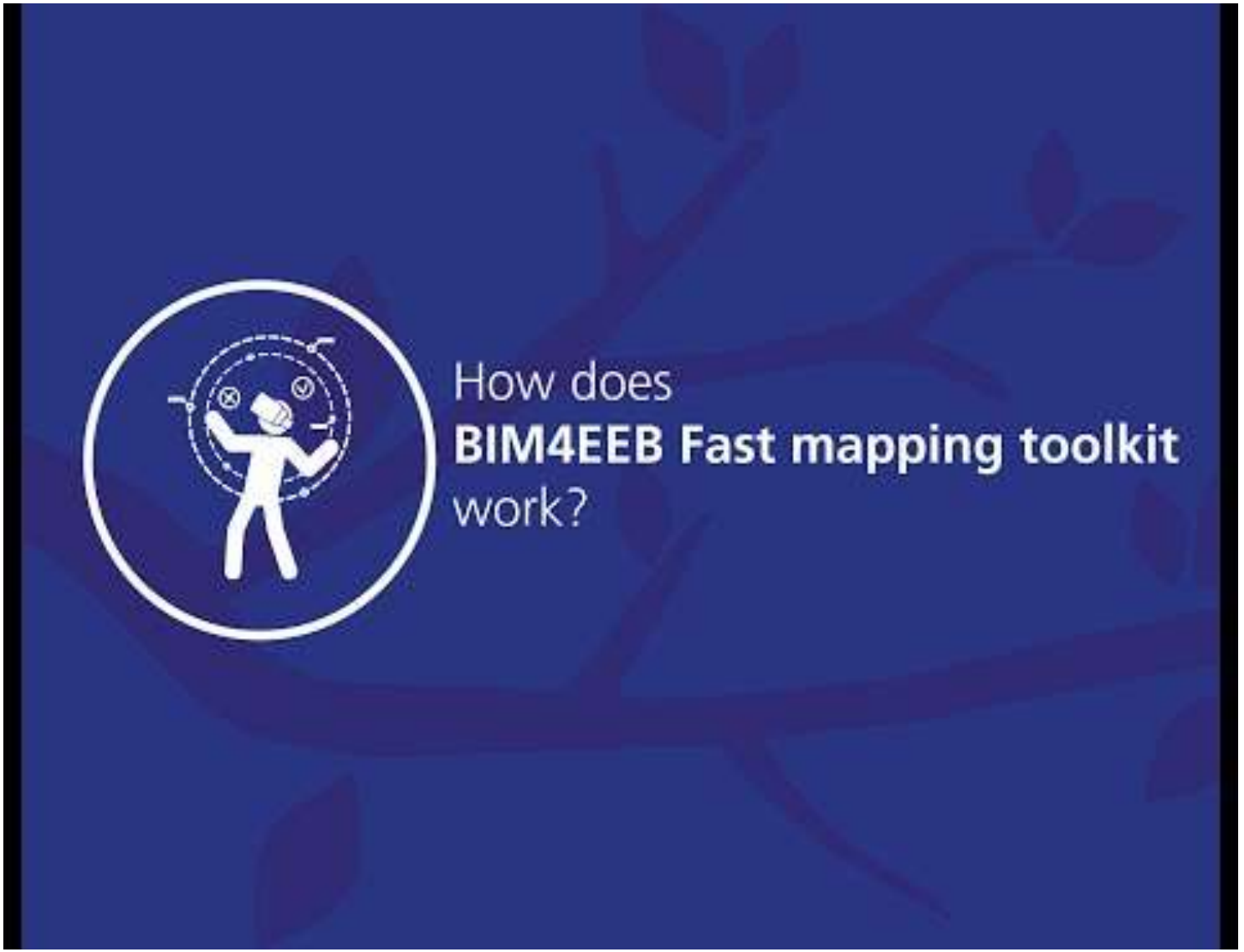
Fast Mapping for Buildings AR-toolkit



After scanning and making a 3D view of room in a building, an IFC-file will be created in the headset device and uploaded it into the BIM Management System, BIMMS.



[Fast mapping tool]



Interactive Poll

What impact do you think the AR-Fast Mapping Tool will have on renovation industry?

Interactive Poll

When will the tool be most useful?

Any questions?

Coffee break
15 minutes

BIMcpd: A combined toolkit for constraint checking, performance evaluation and data management in building renovation projects

Speakers:
Andriy Hryshchenko (UCC), Brian O'Regan (IERC)

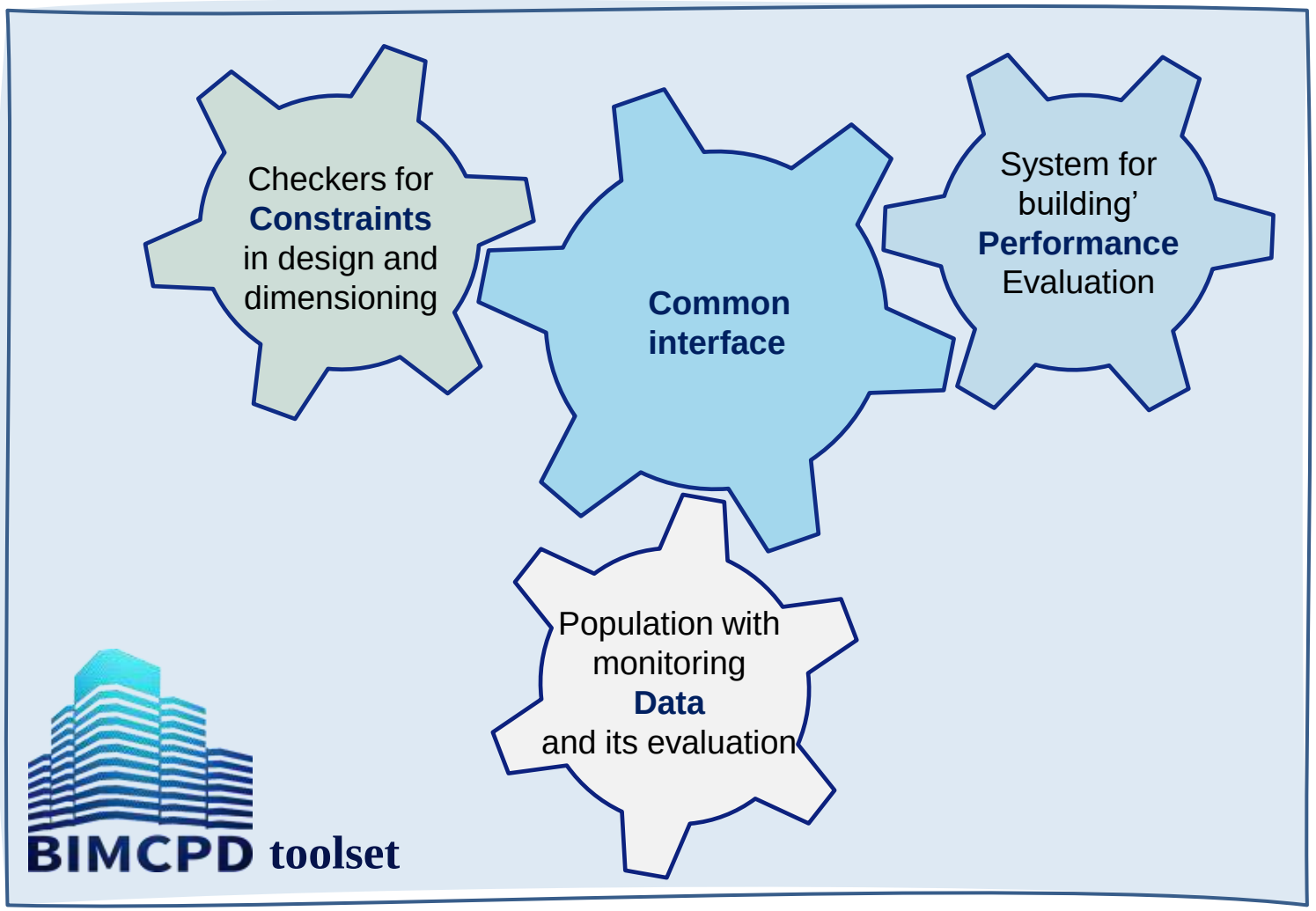
University College Cork – BIM4EEB WP6 Leader

Our aim is to develop digital tools to support the design, procurement, installation, post-renovation operation, user feedback and profiling of building automation systems during and after buildings' renovation processes.

For UCC there are two groups contributing together to different tasks and other internal peer-reviews:

- The Intelligent Efficiency Research Group (IERG) are responsible for overall work package activities;
- The International Energy Research Centre (IERC) is leading predominantly software tasks. They have created a web-based BIMcpd toolset.

UCC: BIMcpd Introduction



Constraint Checking Tool

Aims to:

- find possible positions for ducts and cable runs,
- take into consideration of fire zones, or
- find the position of switches, e.g. for elderly living.

- Further non-functional requirements are install-zones for devices.

Constraint Checking Tool

- Configuration
- Libraries
- Processing
- Dijkstra's algorithm
- Multiple Iterations

Ducting and Diffusors

Cable Runs and Lamps

Constraint Checking Tool

Report

- Heatmap
- Layers

Future work:

- More accurate airflow representation based on BSRIA Rules of Thumb
- BIM Level of Detail
- Building Code Compliance Report

Data Performance Tool

Goals

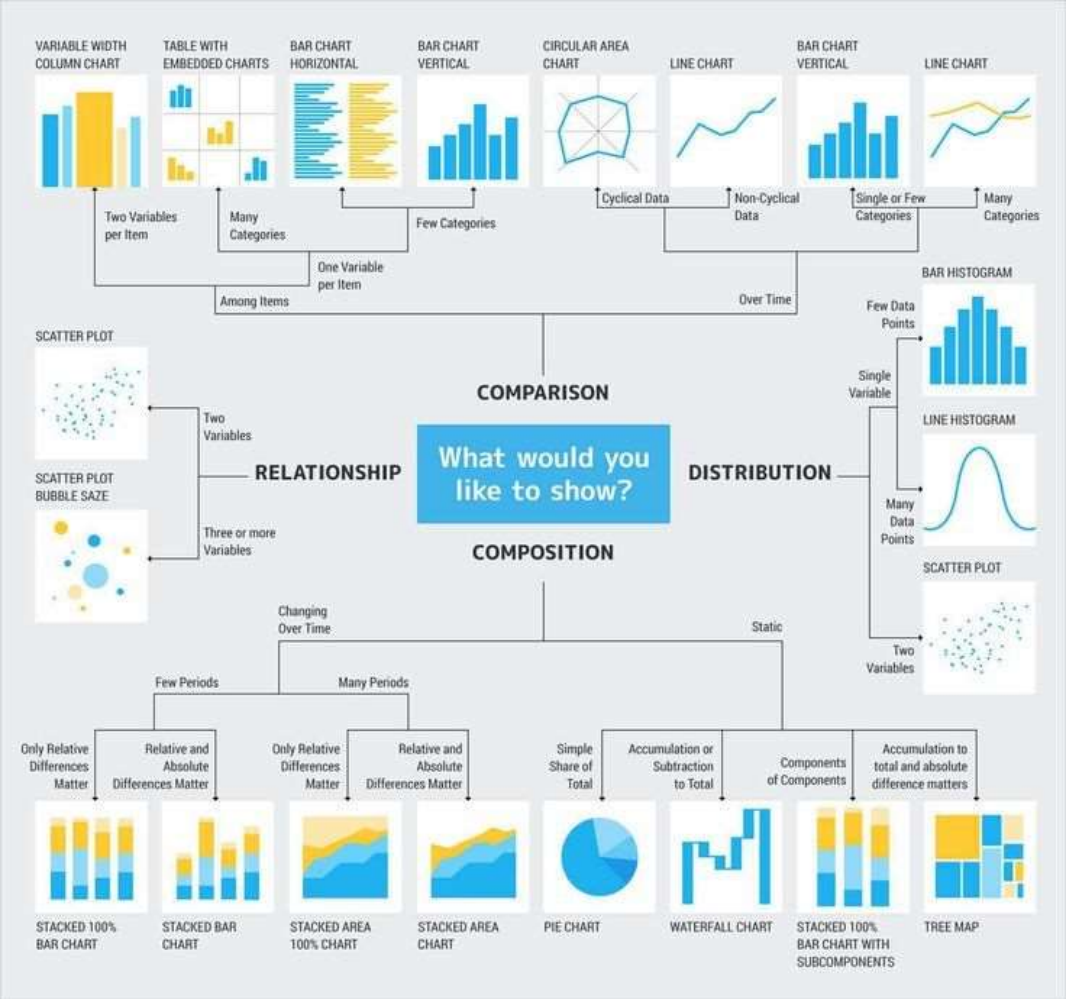
- Quality assessment for building operators,
- User feedback,
- Compliance check between “design intent” and “as built operation”.

The Data Performance Tool aims to:

- develop a BIM-based performance evaluation tool
- related BIM-compatible meta-data schema.
- allow the seamless performance evaluation before and after the renovation case.
- Increase accuracy (Outlier Detection)

Data Represented with and without outliers

Data Performance Tool



Uses the chart selection diagram that was developed by Dr. Andrew Abela for his book Advanced Presentation by Design. The diagram, titled “Chart Suggestion—A Thought Starter,”

BIMcpd automatically displays the data in the most appropriate chart type based on the options selected by the user

Data Performance Tool – M&V

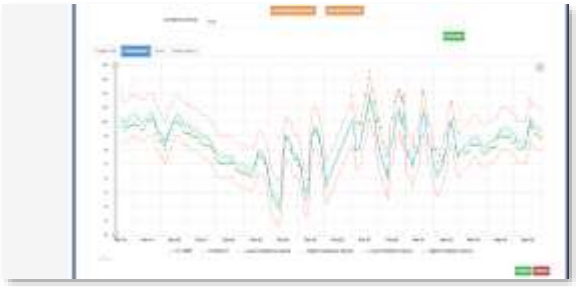
The Measurement and Verification Tool applies the International Performance Measurement and Verification Protocol (IPMVP)

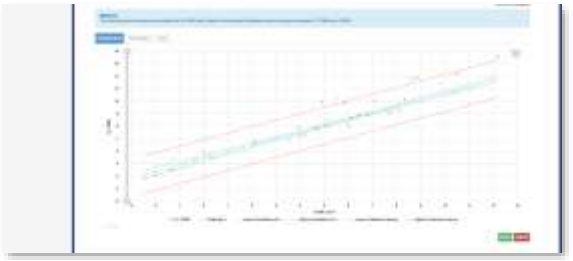
Allows the user to:

- Create a baseline
- Select the reporting period
- Apply Non-Routine Adjustments
- Identify savings

Savings = (Baseline Period Energy – Reporting Period Energy) ± Adjustments

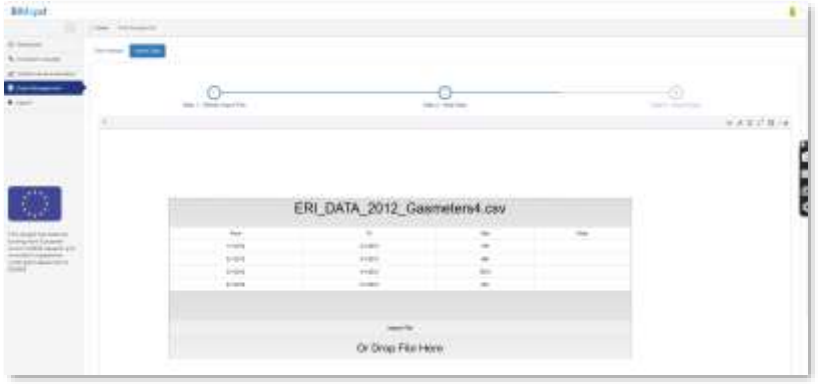
The baseline and reporting periods display data as scatter plot, timeseries and data tables

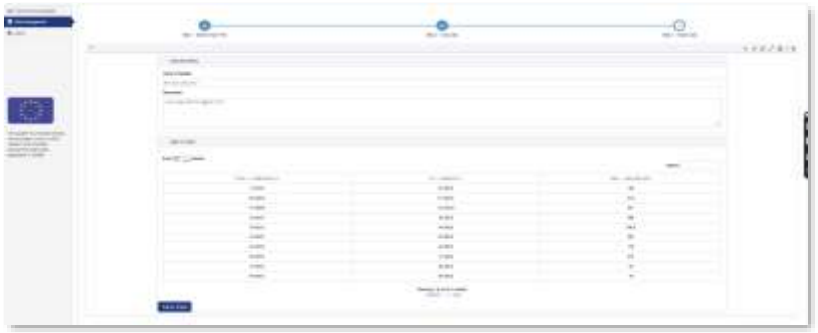




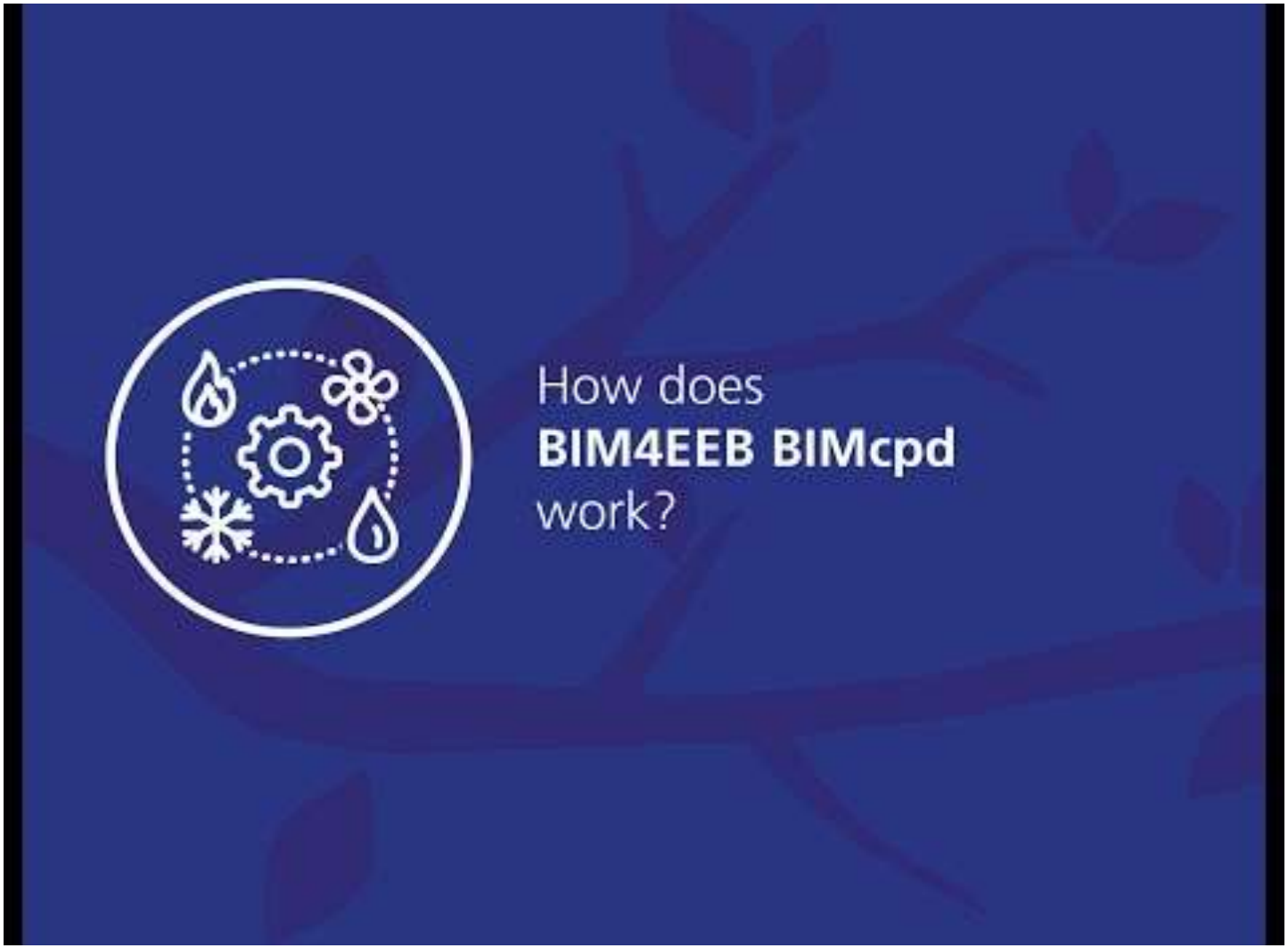
Data Management Tool

- Import building/energy/environmental/people data
- Map to the BIMcpd Data Schema (Project Haystack, amongst others)
- Use data in the Performance Analysis Tool





BIMcpd



Audience feedback - Interactive Pool

Which of the following do you think that the Constraint Checking Tool would be most useful for?

Audience feedback - Interactive Pool

Would you be more or less likely to apply outlier detection algorithms to your data?

Thanks for your attention.

Any questions?

Towards BIM-enhanced renovation management tools with support to stakeholder interaction

Speakers:
Seppo Törmä (VisuaLynk)
Markku Kiviniemi (VTT)
Kostas Tsatsakis (Suite5)

Towards BIM-enhanced renovation management tools with support to stakeholder interaction

Problem

- Renovation projects
  - often take place in buildings where occupants live during the works
  - contain additional uncertainty caused by surprises when structures are opened
- Communication is needed
  - to prevent conflicting activities of contractors and occupants/owners
  - to ensure proper health and safety procedures
- Since uncertainty causes changes, communication needs to be dynamic and flexible

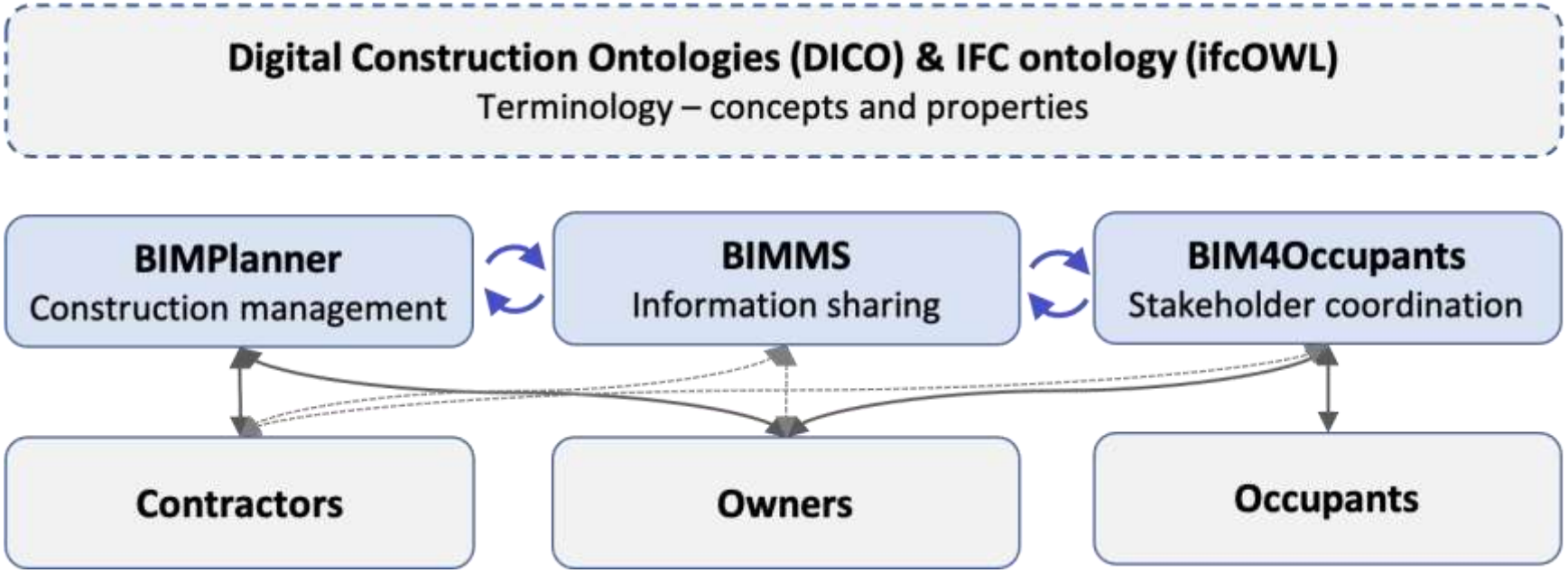
Goal

- Smooth coordination between owners, contractors and occupants

Approach

- BIM-enhanced renovation management based on linked data and ontologies to support interaction among stakeholders

Towards BIM-enhanced renovation management tools with support to stakeholder interaction



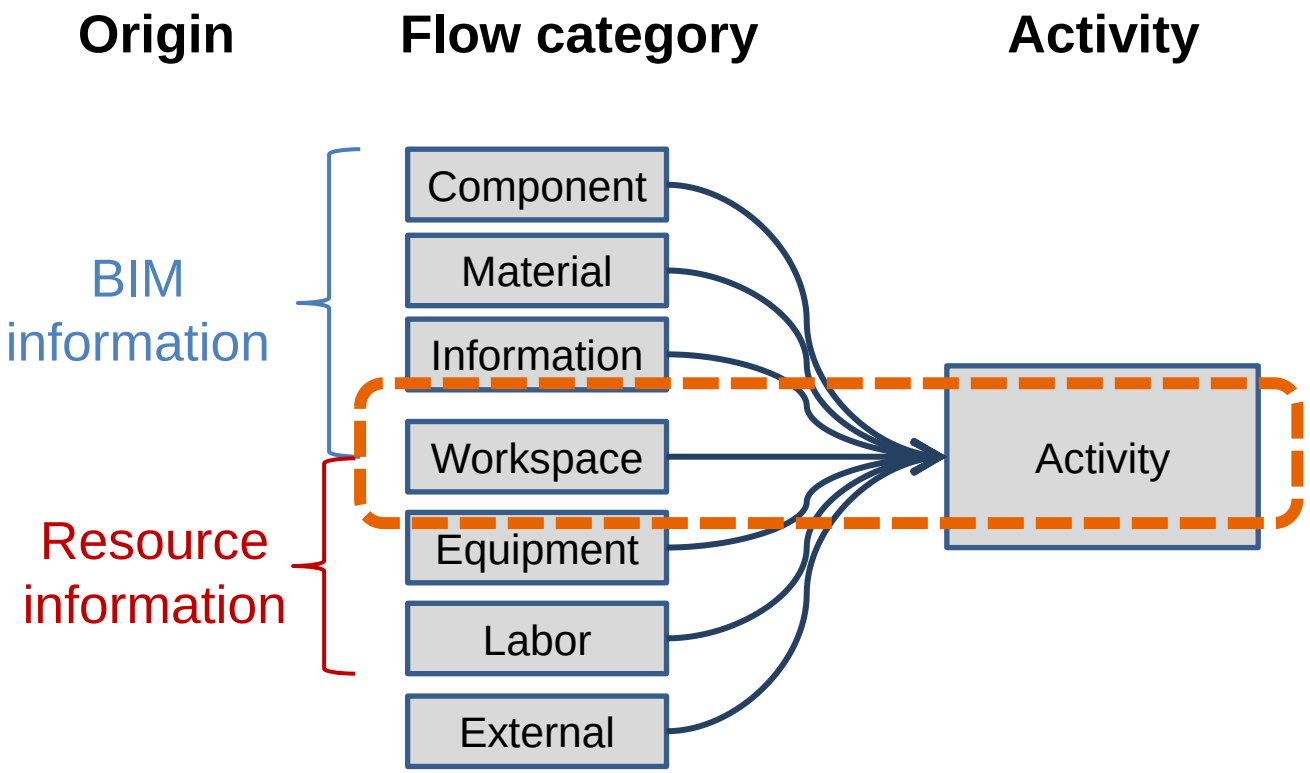
Towards BIM-enhanced renovation management tools with support to stakeholder interaction

BIMPlanner

- Project management software for renovation site operations
- Work location based management with BIM
- Sharing site planning and progress information as Linked Data according to DICO ontologies

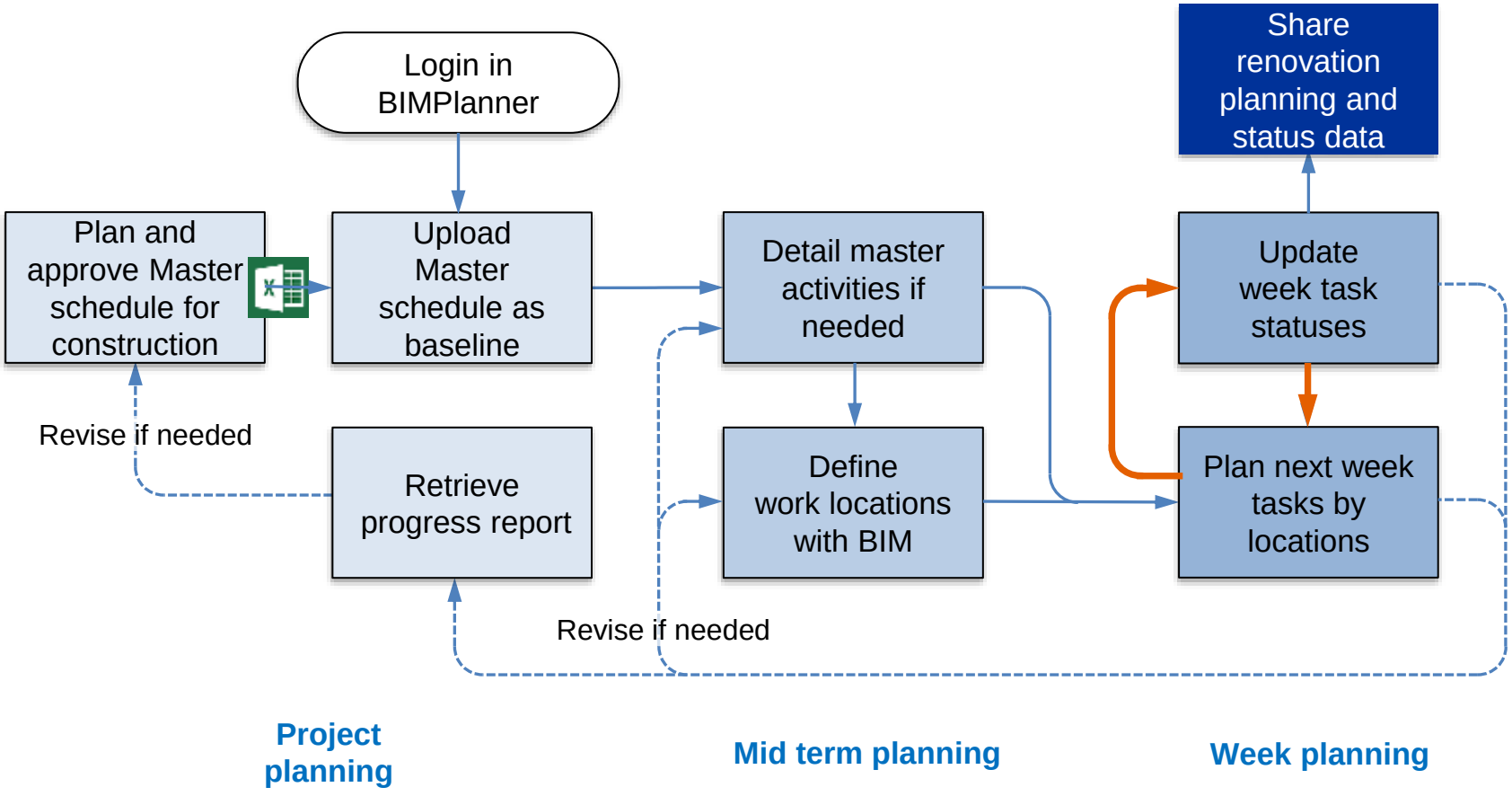
Towards BIM-enhanced renovation management tools with support to stakeholder interaction

Approach: Lean construction – Activity-flow modeling



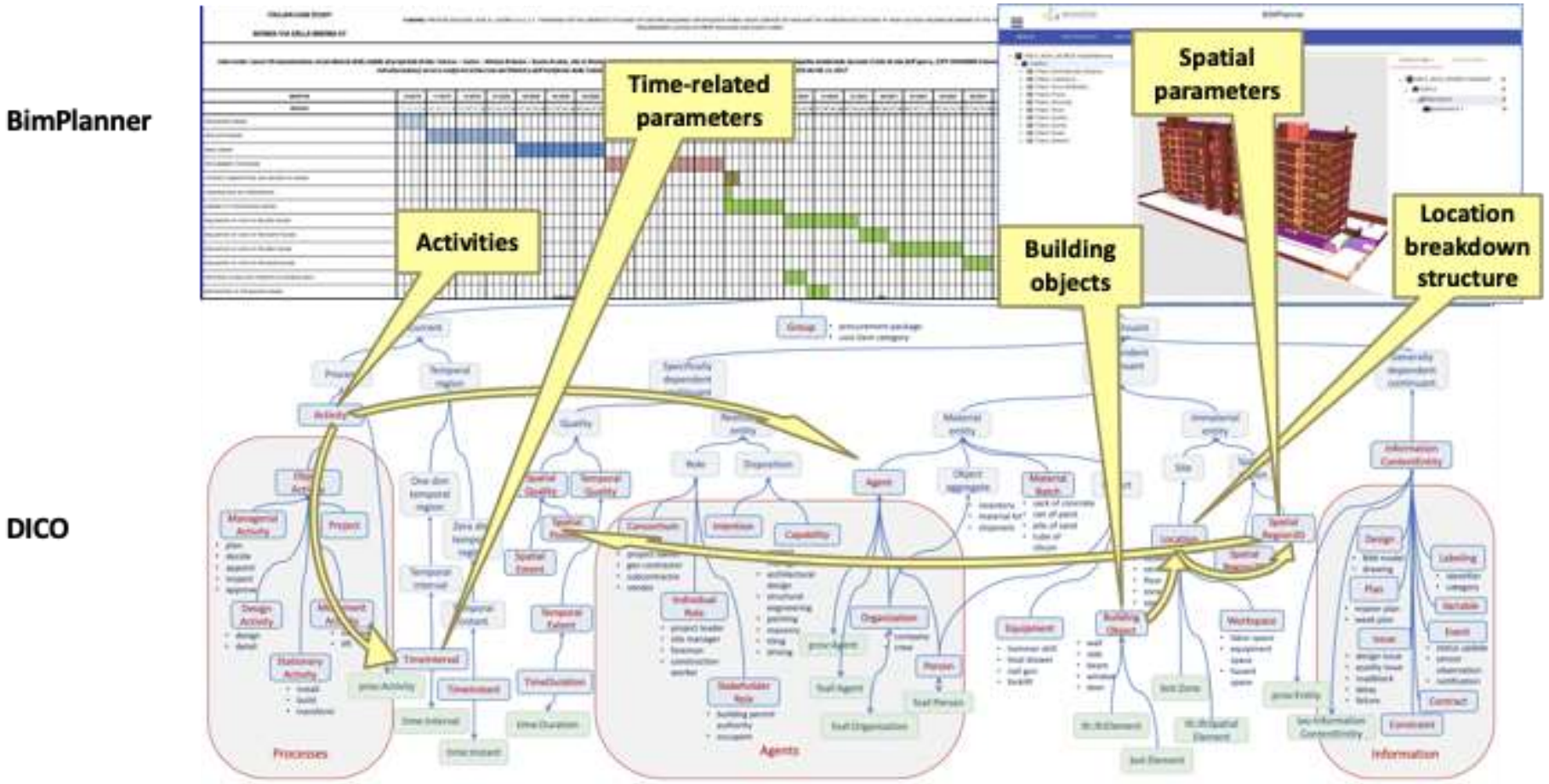
Towards BIM-enhanced renovation management tools with support to stakeholder interaction

BIMPlanner - Use scenario



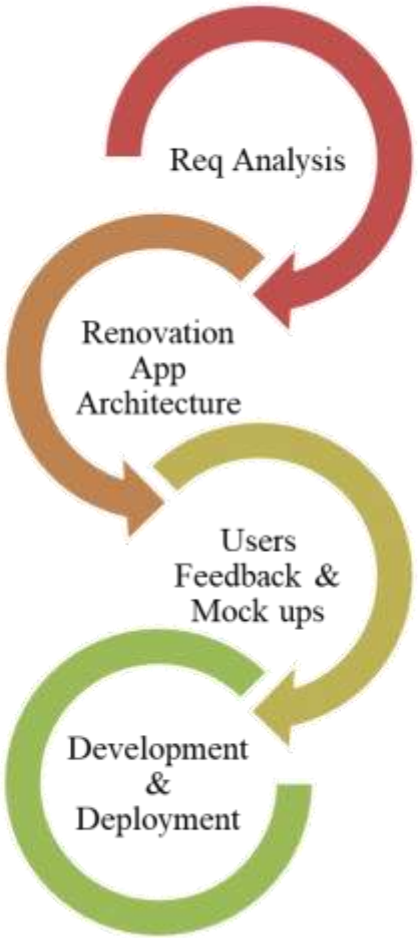
Towards BIM-enhanced renovation management tools with support to stakeholder interaction

Mapping to ontology

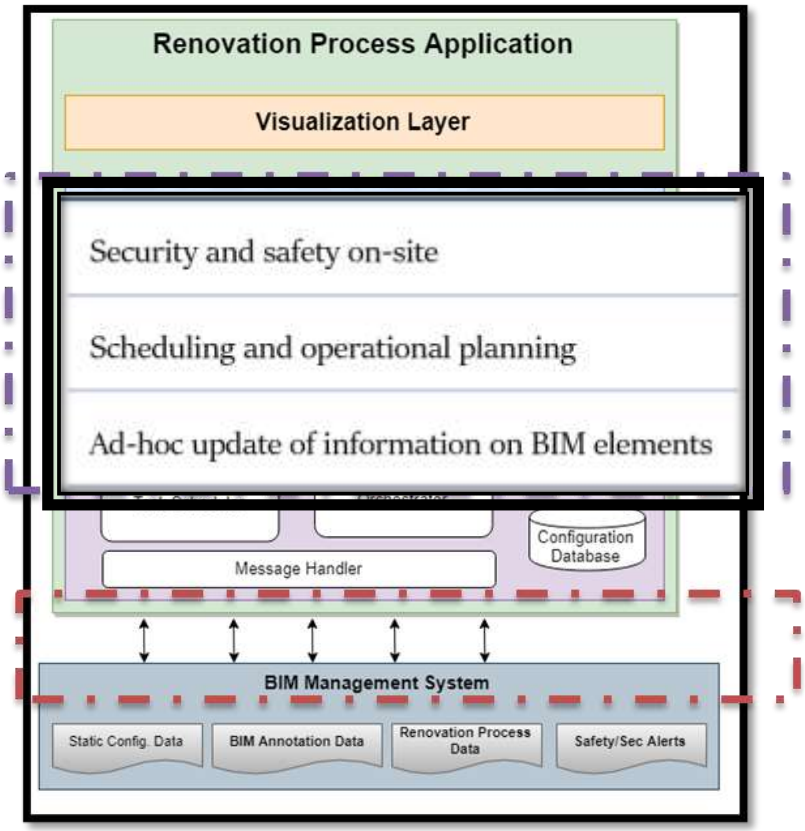


Towards BIM-enhanced renovation management tools with support to stakeholder interaction

Renovation Management Application for Building Occupants



Architecture Definition and Technical Specifications



Design Specs Incorporation

Integration with BIMMS

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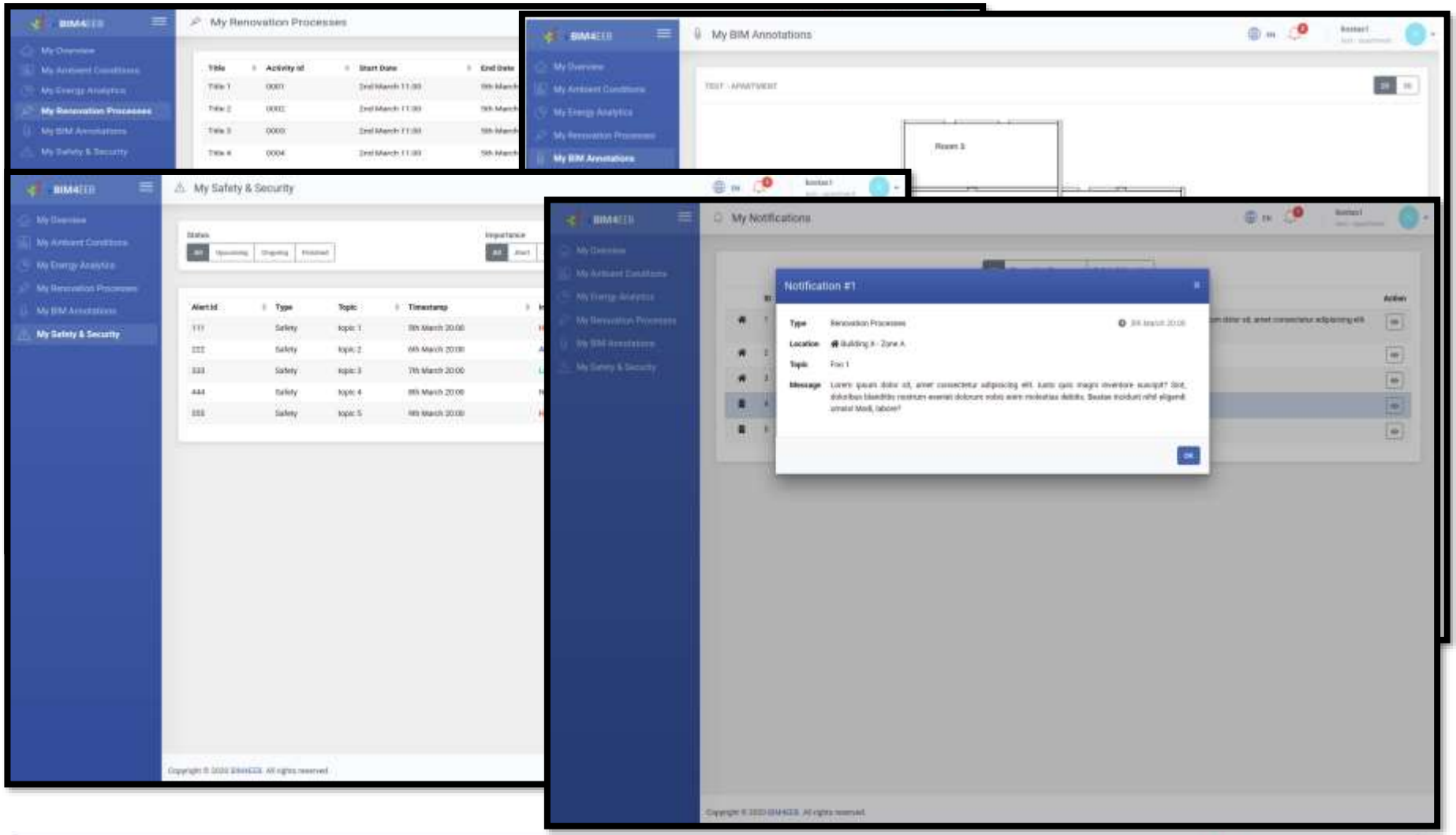
Renovation Management Application Views



Towards BIM-enhanced building construction operations management tools

BIM - Based Framework Demonstration

BIM based framework validation is taking place, in 3 Best Practice Examples under different construction technologies, processes, different climatic, socio-economic, cultural and behavioural contexts.

- Country: Finland
- City: Tampere
- Pilot: Two 5-storey residential buildings built in 1998.

- Country: Poland
- City: Chorzow
- Pilot: 5-storey building with 12 residential apartments and 3 commercial areas.

- Country: Italy
- City: Monza
- Pilot: 8-storey building, with 65 residential apartments

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BIM - Based Framework Validation Action Plan

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Conclusions

- There is ongoing development of two interlinked tools
  - BIMPlanner – renovation management
  - BIM4Occupants – stakeholder interaction
- Validation will happen at pilot sites in Finland and Italy
- Observations gathered so far
  - It is possible to express the required links in the ontologies (DICO and ifcOWL), and convert plans to linked data complying with the ontologies
  - Surrounding systems and practices need to support the planning methods; for example, BIM models should include spaces and zones
  - Proper user interaction methods to establish links and visualize complex linked networks are missing as of yet
  - Software development tools and skills regarding linked data and ontologies are still in early stages of development
- Linked data is a promising enabler to future renovation management systems

BIM4Occupant

Interactive Poll

What is the main obstacle that hinder building occupants participation in the renovation process management activities?

Interactive Poll

Why is communication a bigger problem in renovation that in other construction?

Any questions?

Early stage energy refurbishment assessment tool for buildings using high-end BIM data

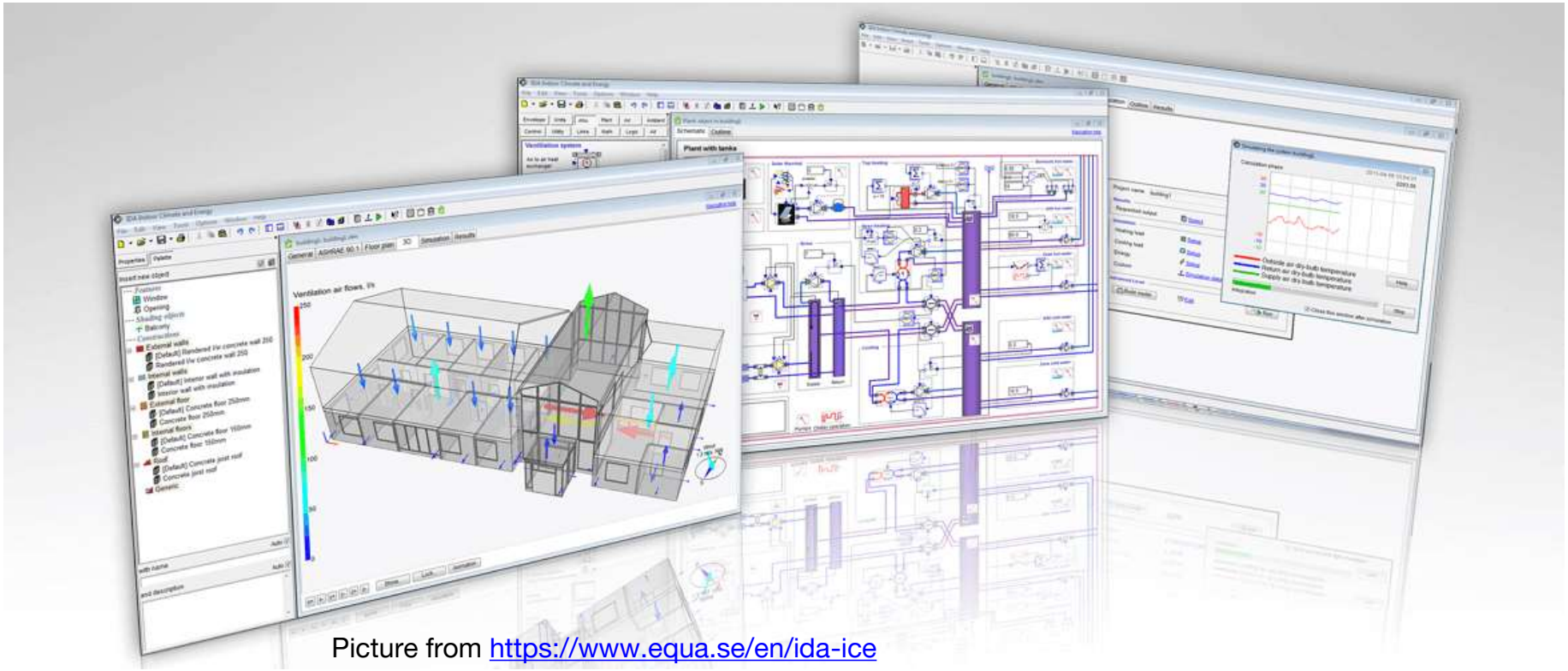
Teemu Vesanen (VTT)

Early stage energy refurbishment assessment tool for buildings using high-end BIM data

- **BIM-assisted energy scenario tool, BIMeaser** was developed in the BIM4EEB project
- The novelty is not in the simulator, but in **a process and a tool** for managing the linked data enriched BIM data to assess the energy performance in a building refurbishment project.

Simulation tools

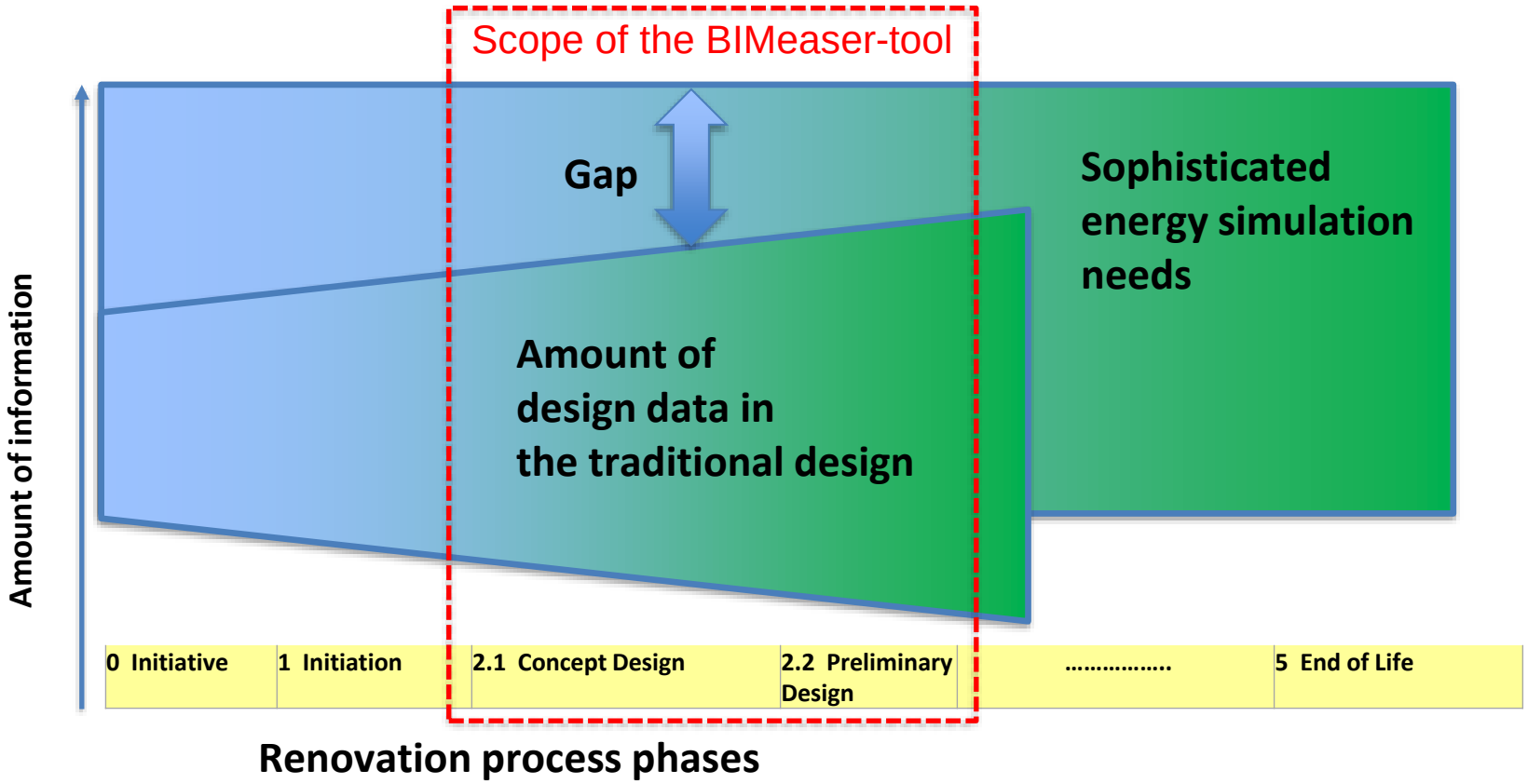
Very sophisticated and well validated simulation tools for energy and indoor climate are commercially available such as IDA Indoor Climate and Energy by EQUA.



Picture from https://www.equa.se/en/ida-ice

The early design stage information gap

The information gap between the early stage information need is filled with the enriched BIM content



BIM Early Stage Energy Scenario tool, BIMeaser

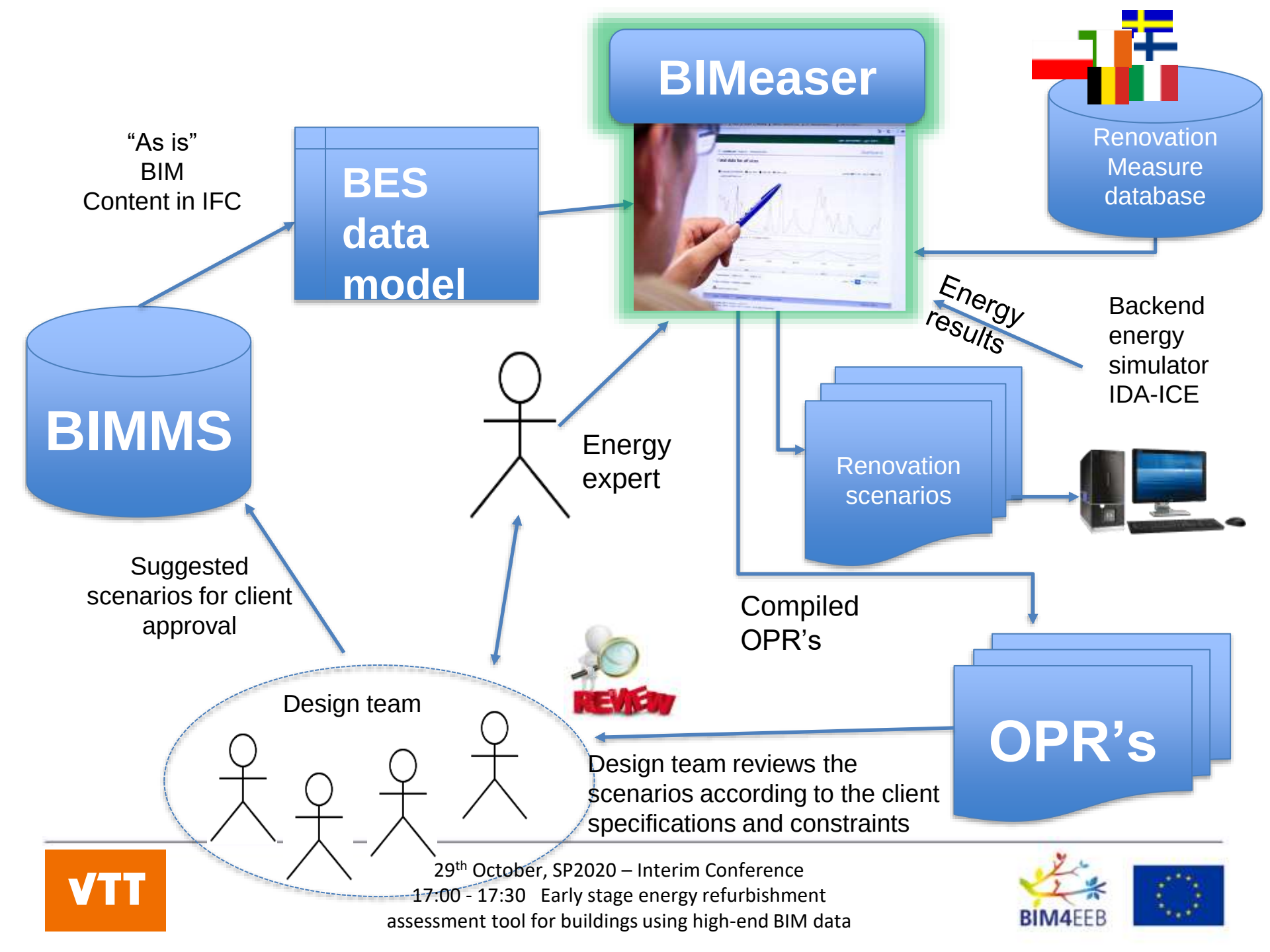
BIMeaser is used several times during the design process. The intended usage is **collaborative** and as automated as possible. Results should be available in an hour → decision making during the design meetings.

The **user** of the tool is an "*Energy expert*".

The targeted **design phases** are: (1) *Concept design* and (2) *Preliminary Design*

The main functionalities of the tool are:

1. To build an **"As is" energy and indoor climate model**
2. To apply the **renovation scenario, which is set of** renovation measures
3. To present the impact of each renovation measure in terms of **Owners Project Requirements (OPR)**


BIMeaser
"As is"
BIM
Content in IFC
BES
data
model
Renovation
Measure
database
BIMMS
Energy
results
Backend
energy
simulator
IDA-ICE
Energy
expert
Renovation
scenarios
Suggested
scenarios for client
approval
Compiled
OPR's
REVIEW
Design team
OPR's
Design team reviews the
scenarios according to the client
specifications and constraints

Currently calculated OPR

Impact criterion	Indicator	Unit
energy savings	Delivered energy (purchased) for heating, cooling and electricity	kWh/m²,a
	Primary energy	kWh-pr/m²,a
	Renewable energy share of solar PV, solar thermal and biofuels	%
comfort	Overheated hours (e.g., hours when operative temperature is over 27 °C or just cooling load)	(-) Number of hours according to criteria for the average zone in building
cost	Total investment cost	(€) Renovation cost of a one scenario, VAT excluded
	Operational energy cost	(€/a) Sum of all delivered energy cost items, VAT excluded
	Payback time of the energy investment	(Years) Payback time of the energy investment for an individual scenario

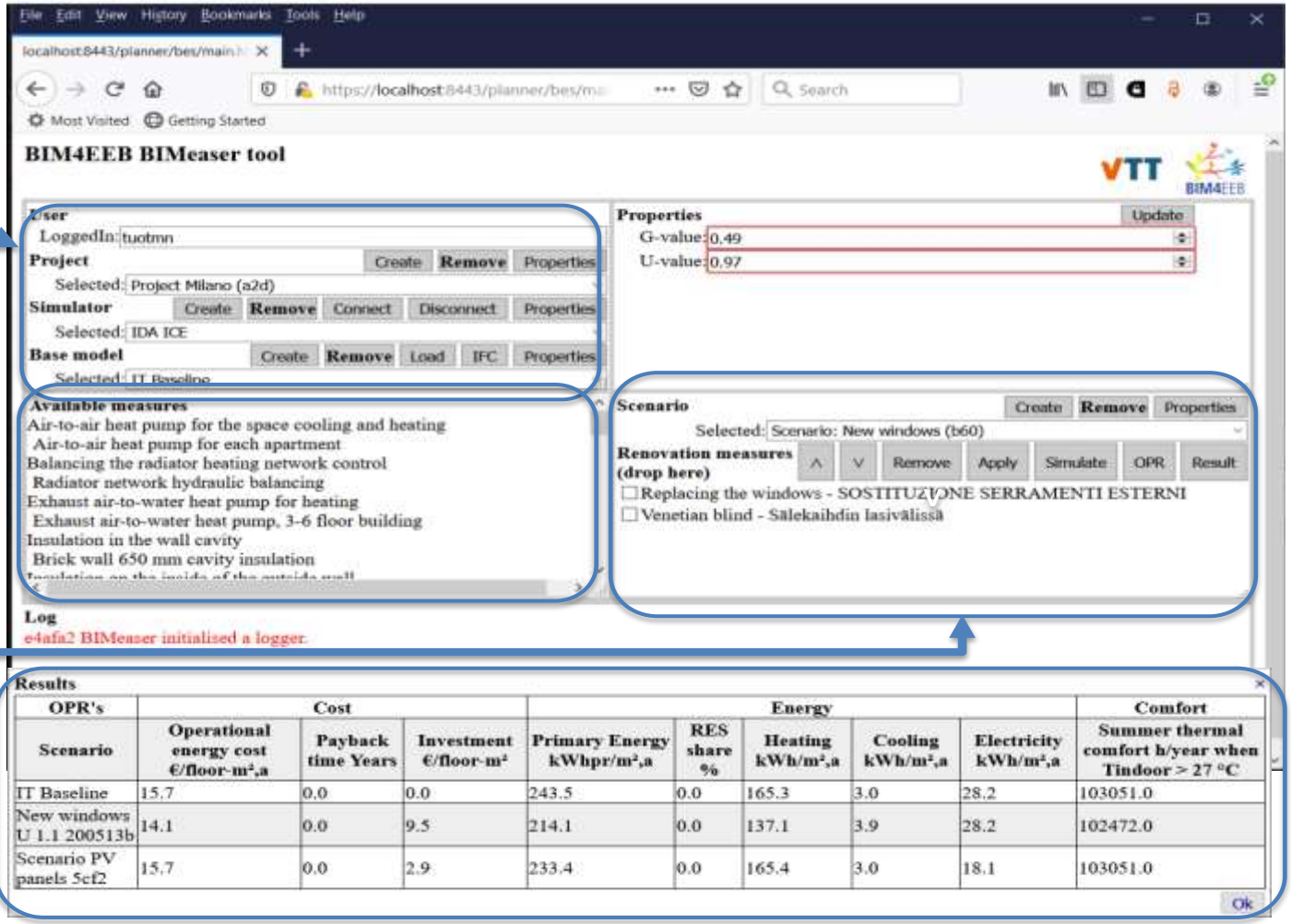
User interface

1. External connections

2. Renovation measure database view

3. Scenario view

4. OPR pop-up view for the result review



Benefits

1. allows accurate build-up of **the As-is models using the BIM and linked data**
   - focus in the early design stage, where most important design decisions are made.
2. allows easy **application of renovation scenarios** to the As-is building
   - predefined renovation measures available in the national database
3. enhances **collaborative work** inside the design team
   - important for buildings' design, which is a multi-domain task that should always be a collective work of the design team members

Challenges

1. The accuracy of the BIMeaser tool relies on the availability of good quality BIM data of the renovated apartment building.
2. The required time for running detailed simulation of large multi-zone apartment buildings models can be long, which may hinder the intended fast collaborative teamwork

BIMeaser

Interactive Poll

Is your work affiliated with a residential building renovation business?

Interactive Poll

Do you think BIM has a role in residential building renovation?

Interactive Poll

Do you think the concept demonstrated with the BIMeaser tool is feasible?

Any questions?

Closure

BIM4EEB

BIM-based toolkit for
Efficient rEnovation in Buildings

Thank you!

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