Digital Twins & BIM

Zürcher Hochschule
für Angewandte Wissenschaften

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IFMA™
International Facility Management Association

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Agenda

Section 1	About Ecodomus
Section 2	Digital Twins and BIM CDE and why it is critical for design, construction and facility management
Section 3	Standards for Project Information Model (PIM), QC and Asset Information Model (AIM)
Section 4	Supporting 2D workflows while upgrading to BIM
Section 5	Integrating BIM with PM, CMMS, CAFM, ERP
Section 6	Mobile BIM and AR/MR (inspections, issues, electronic forms)
Section 7	BIM + Internet of Things (IoT) for optimal building performance
Section 8	Laser scanning technology for 3D asset management
Questions and Answers	

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Ecodomus

The first global Lifecycle BIM firm, Ecodomus, has been acquired by Siemens in 2022.

1. Since 2010, Ecodomus has delivered more BIM for FM projects than all other software companies in the world combined – Unique Experience
2. Ecodomus is working with the top clients in the world and is implementing pioneering practices from the leading facility owners – Best Practices
3. Ecodomus CDE software has more BIM/FM/COBie features than any other BIM software – Higher Quality of Data at Lower Cost

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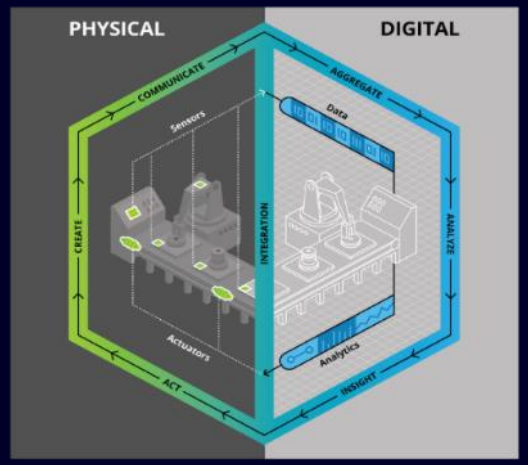
Defining Digital Twin

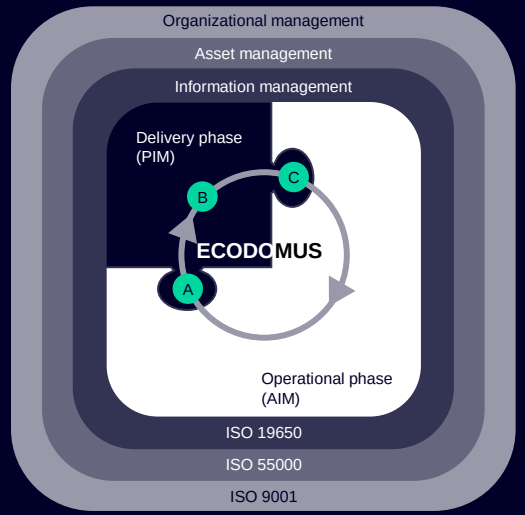
Digital Twin refers to a digital replica of physical assets, processes, people, places, systems and devices that can be used for various purposes. (Wikipedia)

Digital Twin = BIM + IoT + FM + GIS + …



Source: Deloitte University Press

- How it is *supposed* to work – BIM/CIM design apps (Autodesk Revit, Bentley OpenBuildings, ArchiCAD, etc.)
- How it *actually* works – IoT/SCADA/BAS/BMS (Schneider Electric, Siemens, etc.)
- To build a Digital Twin you need a BIM CDE that works both with PIM (Project Information Model) and AIM (Asset Information Model) and is connected to IoT systems.
- The best solution for that – **Ecodomus**



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Digital Twin as a System of Integrated Applications and Databases

BIM as the “lowest common denominator” contains the information relevant to all other facility related systems, thus enabling integrations not available in the past.

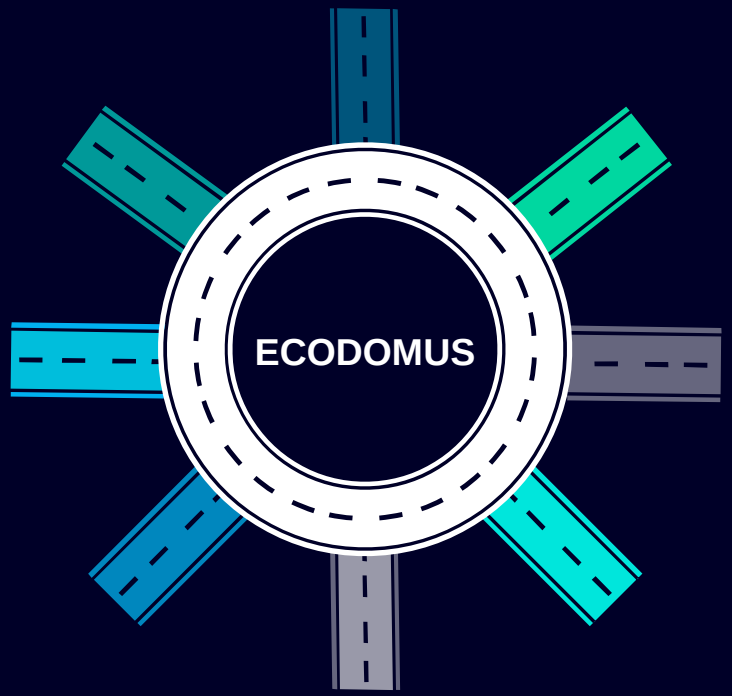
Building Geometry Authoring (BIM)
Autodesk Revit, Bentley AECOsim, Graphisoft ArchiCAD, Tekla, IFCs

Space Management (CAFM/IWMS)
Oracle Unifier, TRIRIGA, ARCHIBUS, Planon, Manhattan, etc.

Maintenance Management (CMMS)
IBM Maximo, Brightly, Accruent, eMaint, FSI, TMA, AssetWorks, Corrigo, etc

Augmented Reality, AI/ML, Predictive maintenance, Process simulation, energy analysis, etc.

Enterprise Resource Planning (ERP)
SAP, Oracle Financials, IFS, Infor, etc.



Electronic Document Management Systems (EDMS)
ProjectWise, Autodesk 360 Docs, Aconex, Alfresco, BlueCielo, etc.

Drones for indoor/outdoor navigation: Space mapping, deliveries, video streaming, inspections, etc.

Geographical Information System (GIS)
CityGML, IndoorGML, ESRI ArcGIS, Mapbox, Oracle Spatial

Project Management (PM)
Procore, Primavera P6, Oracle Unifier, PMWeb, Prolog, e-Builder, etc.

Building Automation System (BAS/IOT)
Siemens Desigo CC, Microsoft Azure IoT, JCI, Schneider Electric, OPC, BACnet, etc.

QR/Barcodes, RFID, CCTV, vibration sensors, concrete sensors, etc.

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Ecodomus Digital Twin Example

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Lifecycle CDE for Digital Twin Management

Definition › CDE (Common Data Environment) is a central repository where facility information is housed. The contents of the CDE are not limited to assets created in a 'BIM environment' and it will therefore include documentation, graphical model and non-graphical assets. In using a single source of information collaboration between project members should be enhanced, mistakes reduced, and duplication avoided.

Design

- BIM is created for visualization, coordination and as a reference for construction
- Design-intent attributes are entered

Ecodomus' Role

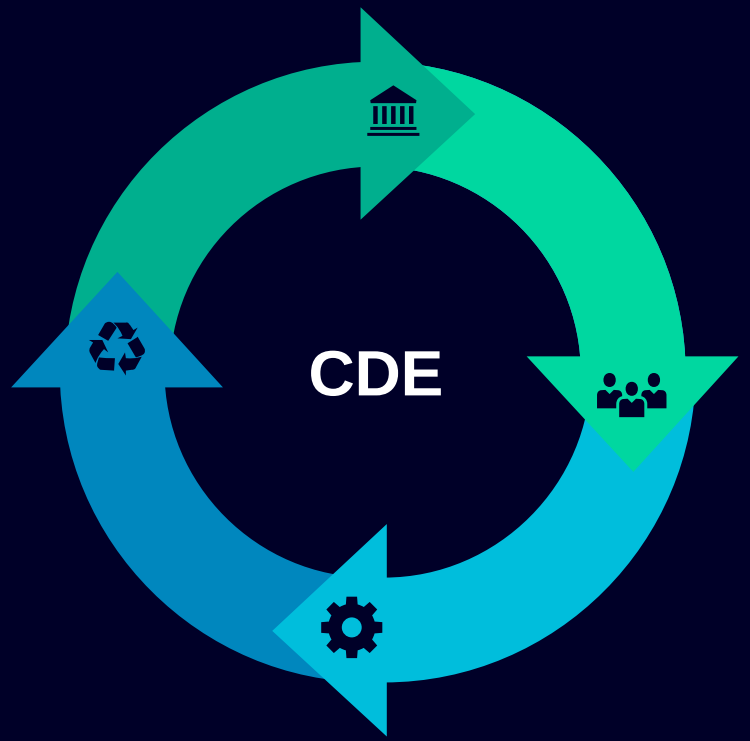
1. Check model data for program compliance and handover to construction
2. Visualize design intent in a browser-based 3D viewer for contractors and FM
3. Collect information outside of BIM authoring tools

Renovation & Upgrades

- Planning renovations in 3D BIM
- Enhanced condition assessment

Ecodomus' Role

1. Provide accurate as-built information for redesign
2. Synchronize as-built updates with the other apps: CMMS, Energy, etc.



Construction

- BIM is updated to 3D as-built
- Installation and Cx attributes are provided
- Linking asset and project documents to BIM

Ecodomus' Role

1. Check model data for handover to O&M
2. Visualize models in a browser-based 3D viewer for project collaboration (GC/subs)
3. Collect information outside of BIM authoring tools, link documents to BIM objects

Operation & Maintenance

- 3D visualization for work orders
- Shutdown planning
- Disaster response
- BIM for energy analysis

Ecodomus' Role

1. Visualize models in a 3D viewer for O&M/property management, including integrated data from BAS/CMMS
2. Generate reports (regulatory, procurement, energy analysis, etc.)

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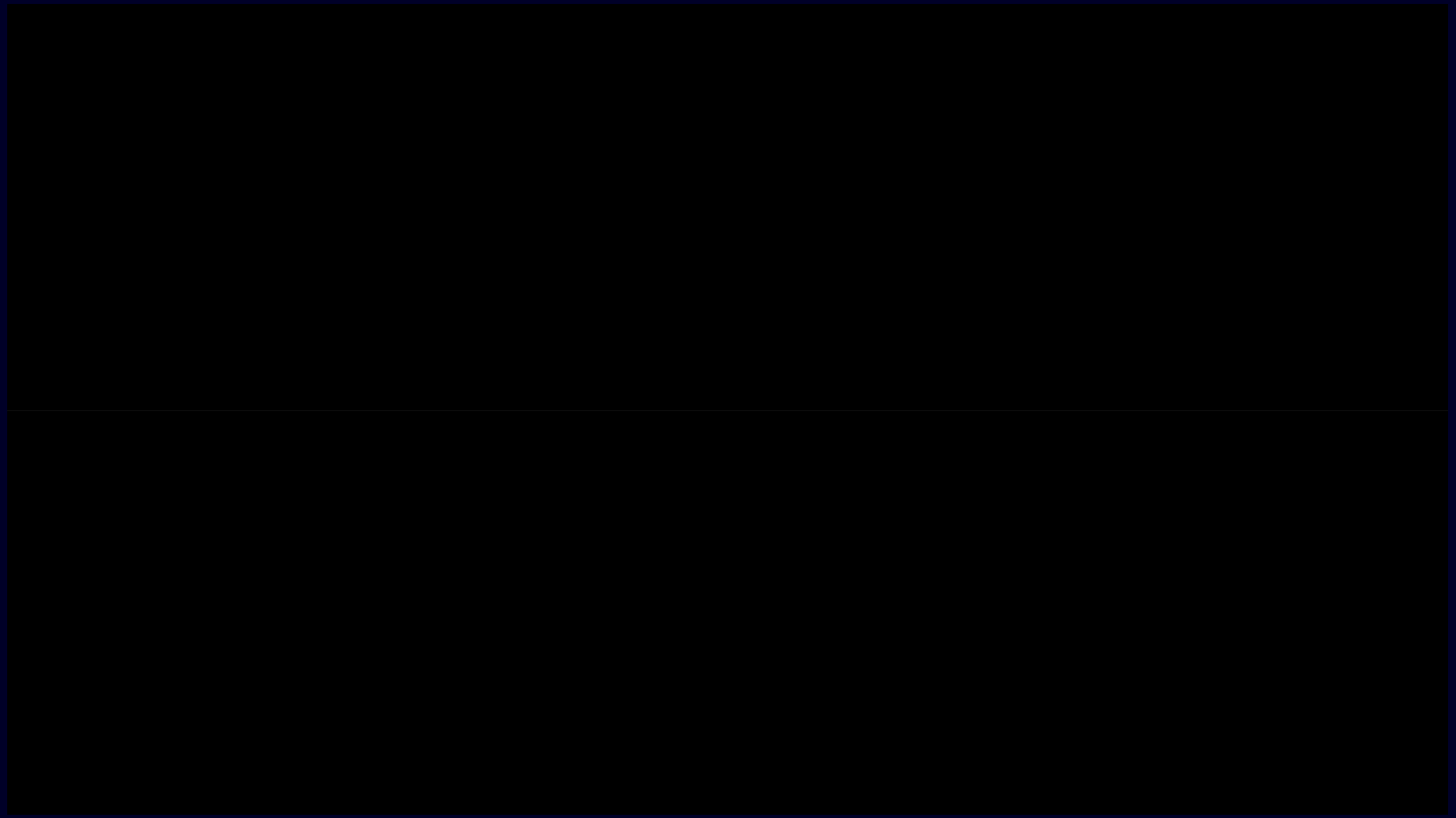
Ecodomus CDE Case Study



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Digital Twin Benefits Time Savings and Impact

- Use Case analysis from Ecodomus' project with the leading healthcare organization
- Benefits are related not just to time/ cost savings but more importantly to the impact on operations
- Digital Twins are created based on the use cases selected by the client

Comparison – Shutdown

Major Plumbing Leak

BASELINE PROCESS	Time Spent	BIM MODEL PROCESS	Time Spent
1. Work Order Submittal 2. Staff Investigation and research 3. Determining ladder and equipment access	2.5 hours	1. User access the BIM model and locates the room. Looks at systems above ceiling and finds optimal isolation valves. 2. En route, staff discuss system with systems engineer and gets a link to access the BIM files in the room. The systems and valves are highlighted.	0.75 hours

BIM Process Key Distinctions

- Time Savings = 1.75hours per instance (70% less time)
- SCALE IMPACT
  - Number of Annual Events: 24
- Time Savings: 35 Hours per instance (62% less time)
- SCALE IMPACT
  - Number of Annual Events: 96
- Average savings/year = 3,402hrs

Planned Utility Shutdown

BASELINE PROCESS	Time Spent	BIM MODEL PROCESS	Time Spent
1. Utility shutdown request for an electrical panel. 2. Contractor requests as-builts from facilities 3. Contractor traces the system in the field 4. Facilities receives shutdown request 5. Utility Shutdown request review 6. Utility shutdown request approved and 7. Building occupants are notified of any impacts. Mitigation measures (back-up power, generator, etc.) are in place during shutdown.	56 Hours	1. Contractor submits utility shutdown request and reviews BIM model. 2. Contractor traces system in the field and uses BIM model to verify the systems and view electrical panel data 3. Facilities AND management reviews BIM Model. 4. Utility shutdown request approved. 5. Building occupants are notified of any impacts. Mitigation measures (back-up power, generator, etc.) are in place during shutdown.	21 Hours

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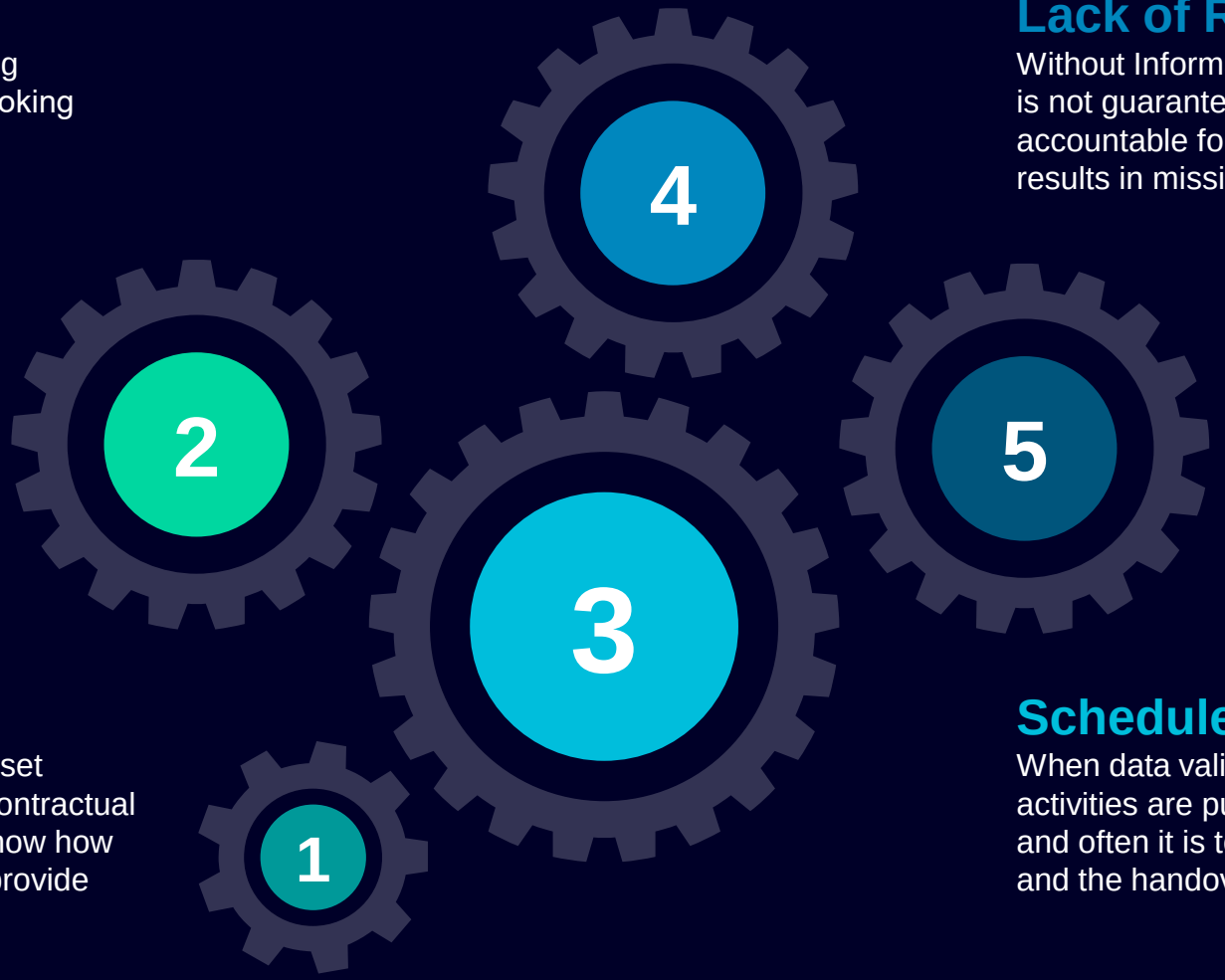
Data Management Issues and Consequences

Wrong Processes

Most modelers disregard BIM authoring tools' capabilities and produce good looking 3D models that are **not information models**, and do not provide much value to facility owners.



Lack of Responsibility

Without Information Managers the quality of data is not guaranteed. Data providers are not held accountable for their quality of work which often results in missing data.

Wrong Tools

Inexperienced providers, or those not incentivized by owners, try to use free tools and manual labor, resulting in higher total costs, poor data quality, and issues with data updates.

No Requirements

When facility owners do not specify asset types, attributes, documents, etc. as contractual requirements, their providers do not know how to price the job, and most of the time provide very little **useful** information.

Schedule Delays

When data validation milestones are not defined, all activities are pushed to the final stages of the contract, and often it is too late to find missing information, and the handover is delayed by months.

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Information Model Requirements

How

How is the data prepared and collected:
is BIM geometry adequate for data export?
Are MEP systems connected? How to
establish relationships between objects?

What

What data is required: asset types,
attributes, document categories,
system levels, zone types?
What are the nomenclature rules
for assets, spaces, systems, etc.?

When

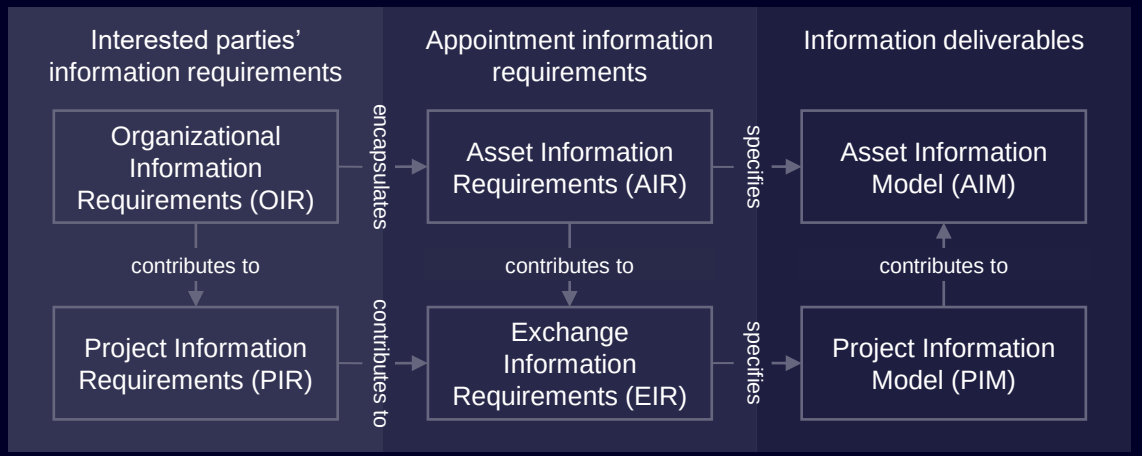
What are the milestones,
incentives and penalties
for data checking?

Who

Who provides the data and who checks
and validates it (Responsibility Matrix)?
Who updates the 3D model?
Who collects field data?

Where

Where is the data managed:
in Ecodomus? Excel? Revit?



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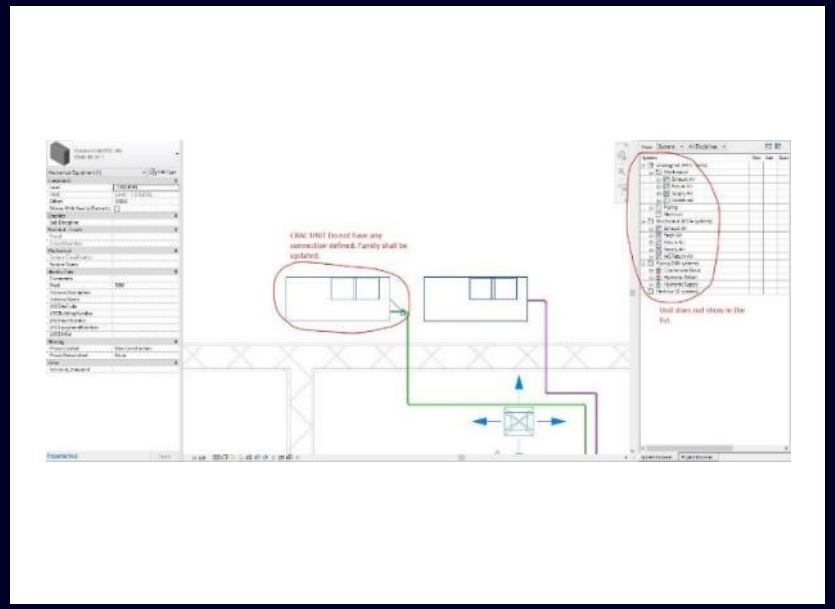
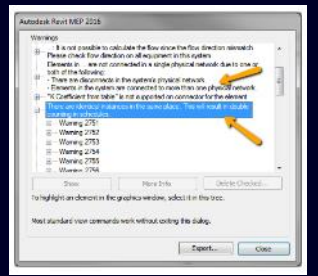
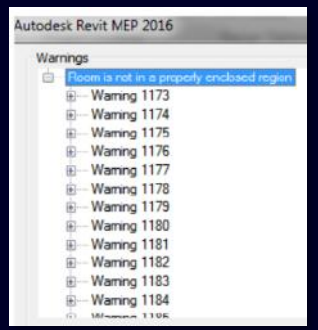
Average BIM vs. Useful BIM

Average “BIM” Project

- Focuses on 2D Deliverables
- Asset names are cryptic
- Properties are missing or wrong
- Building Systems (MEP) are not defined or connected
- Geometry issues (duplicate assets, surface overlaps etc.)

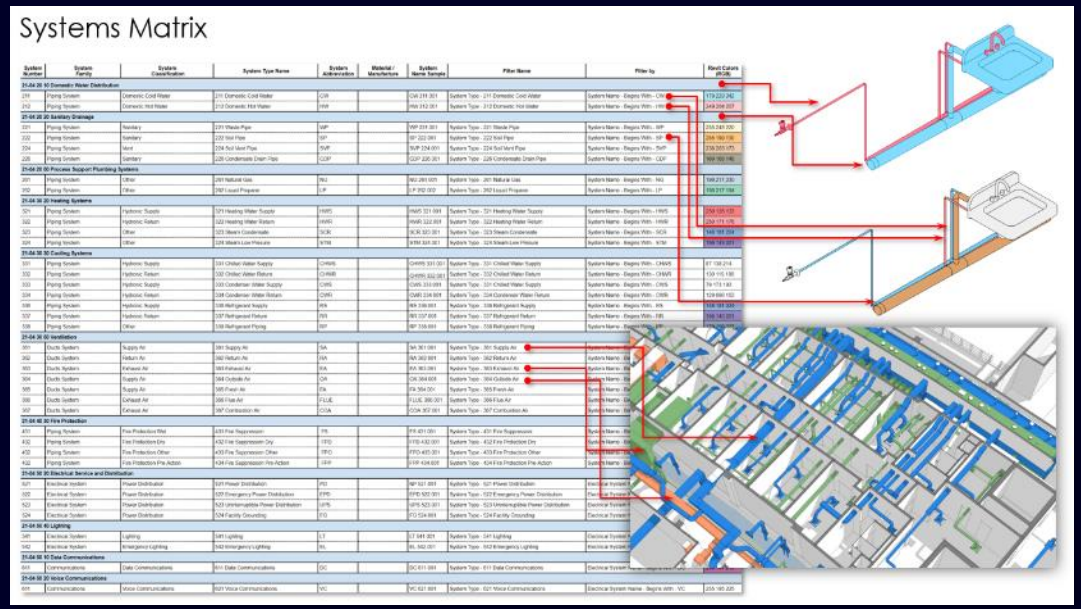






Useful BIM Project

- Focuses on 3D + Data
- Asset names meet owner requirements
- Properties are verified
- Building systems (MEPF) show actual connections
- Geometry issues are resolved – easy to navigate and get data



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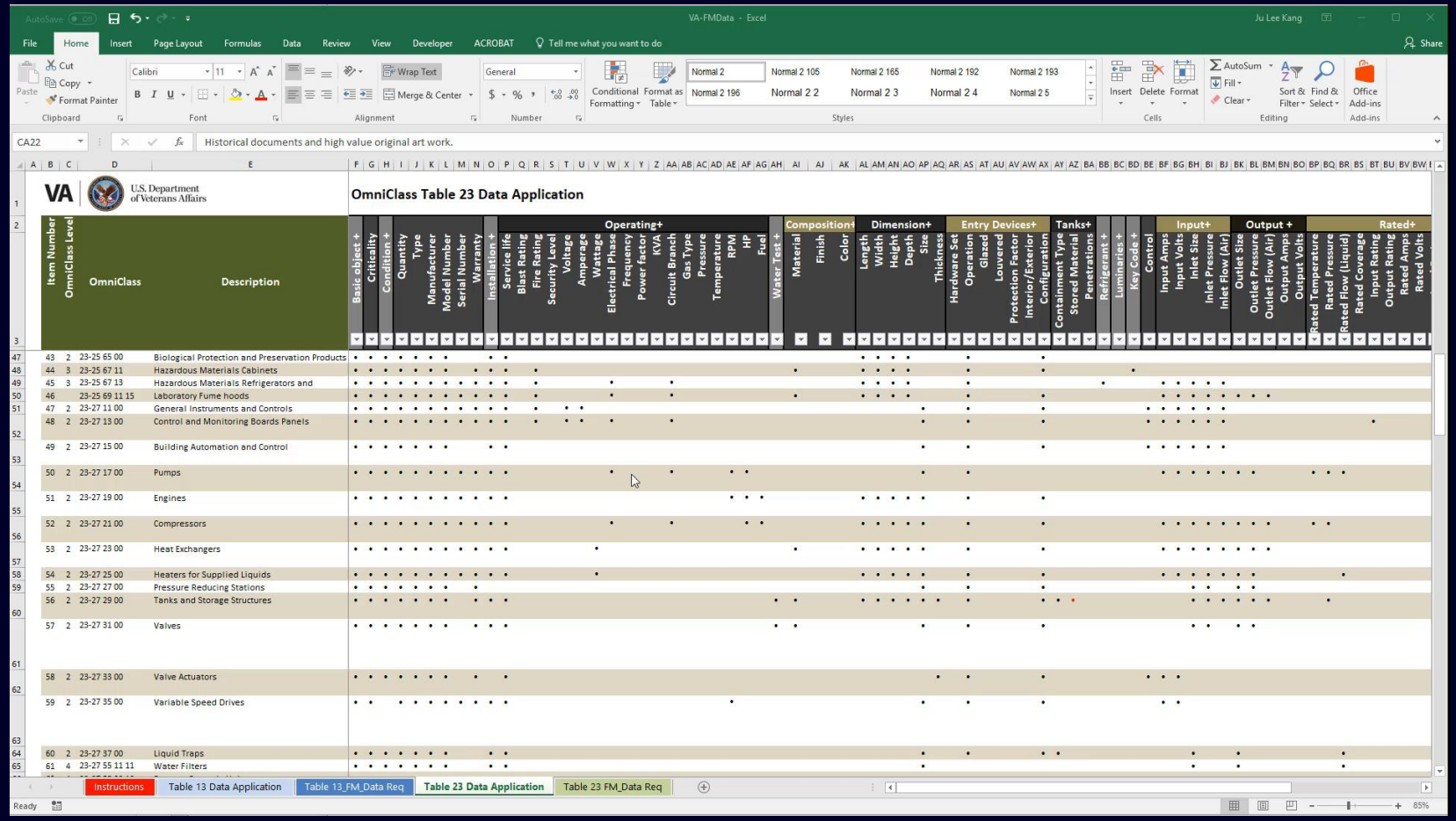
Data and Documents Quality Control for AIR



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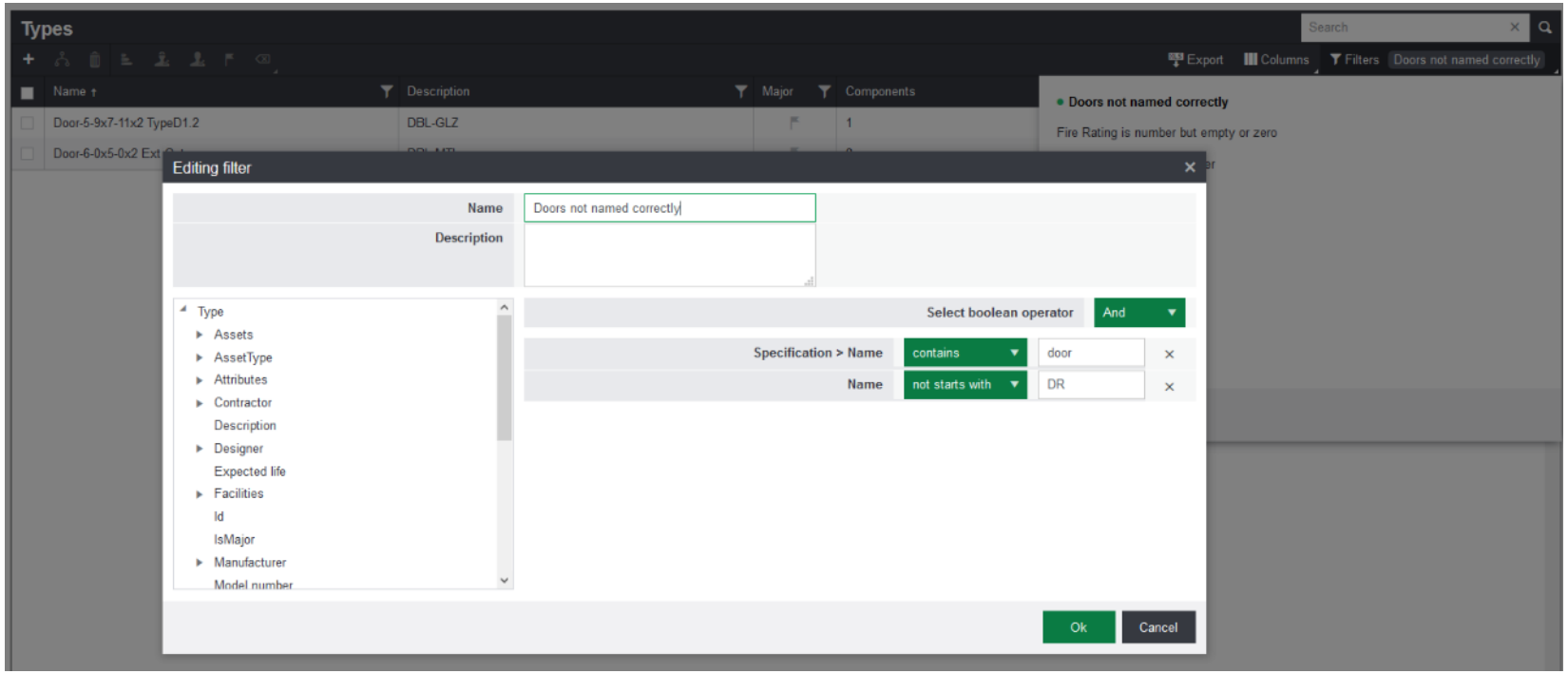
Rule-based Filters/Custom Saved Queries

Create rules and use them as saved queries to monitor quality throughout the project.

- Example on the left shows doors (OmniClass contains the word “door”) that do not start with “DR” as requested by the owner’s requirements



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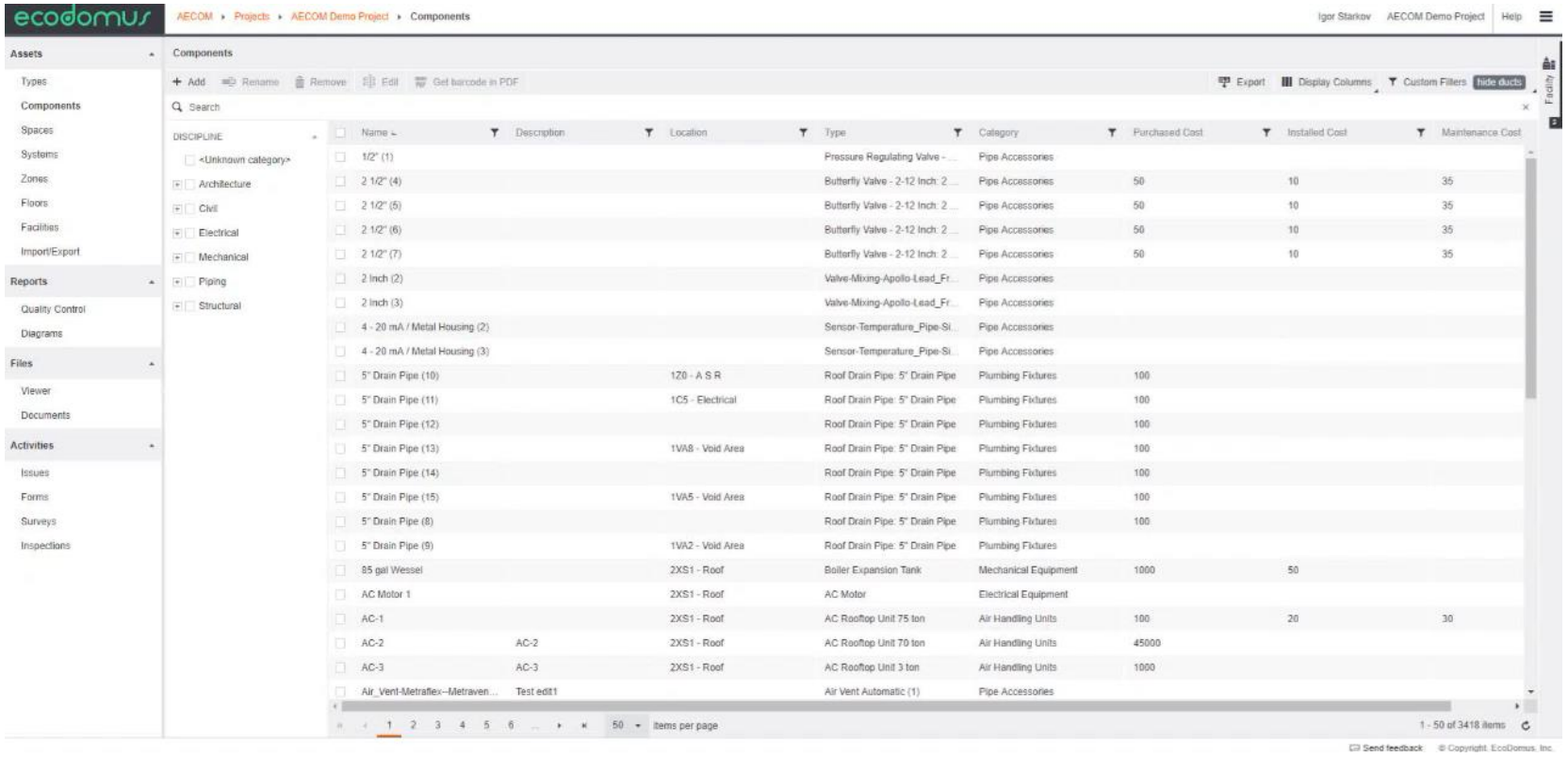

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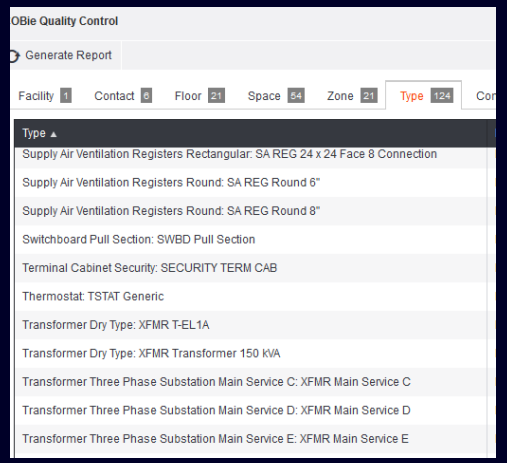
Ecodomus BIM Data Management Benefits

1

Create Useful BIM

Ecodomus BIM and Data experts have unmatched experience in preparing models and datasets for the successful handover. BIM for FM modeling has unique requirements that most modelers do not know, and as a result, most so-called BIMs have limited value for FM.



2

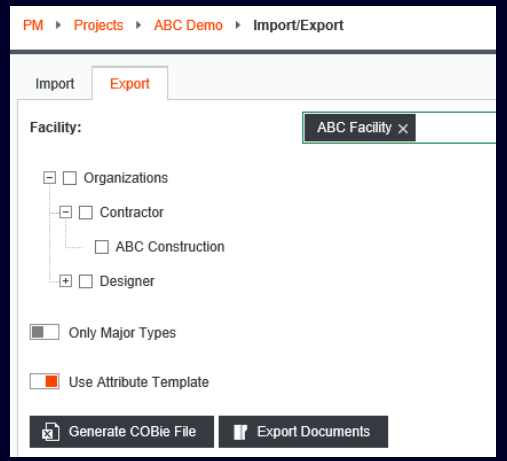
Quality Control

Ecodomus PM's automated quality control features allow for checking attributes and documents for compliance with facility owner's requirements.

3

Many Ways of Data Entry

Ecodomus PM allows entering data via a web browser interface, mobile devices, or export COBie Excel files, update them, and re-import into Ecodomus to update values.



4

Optimization

Ecodomus PM and BIM Connector help filter data to reduce unnecessary data collection, focusing attention on the required data.

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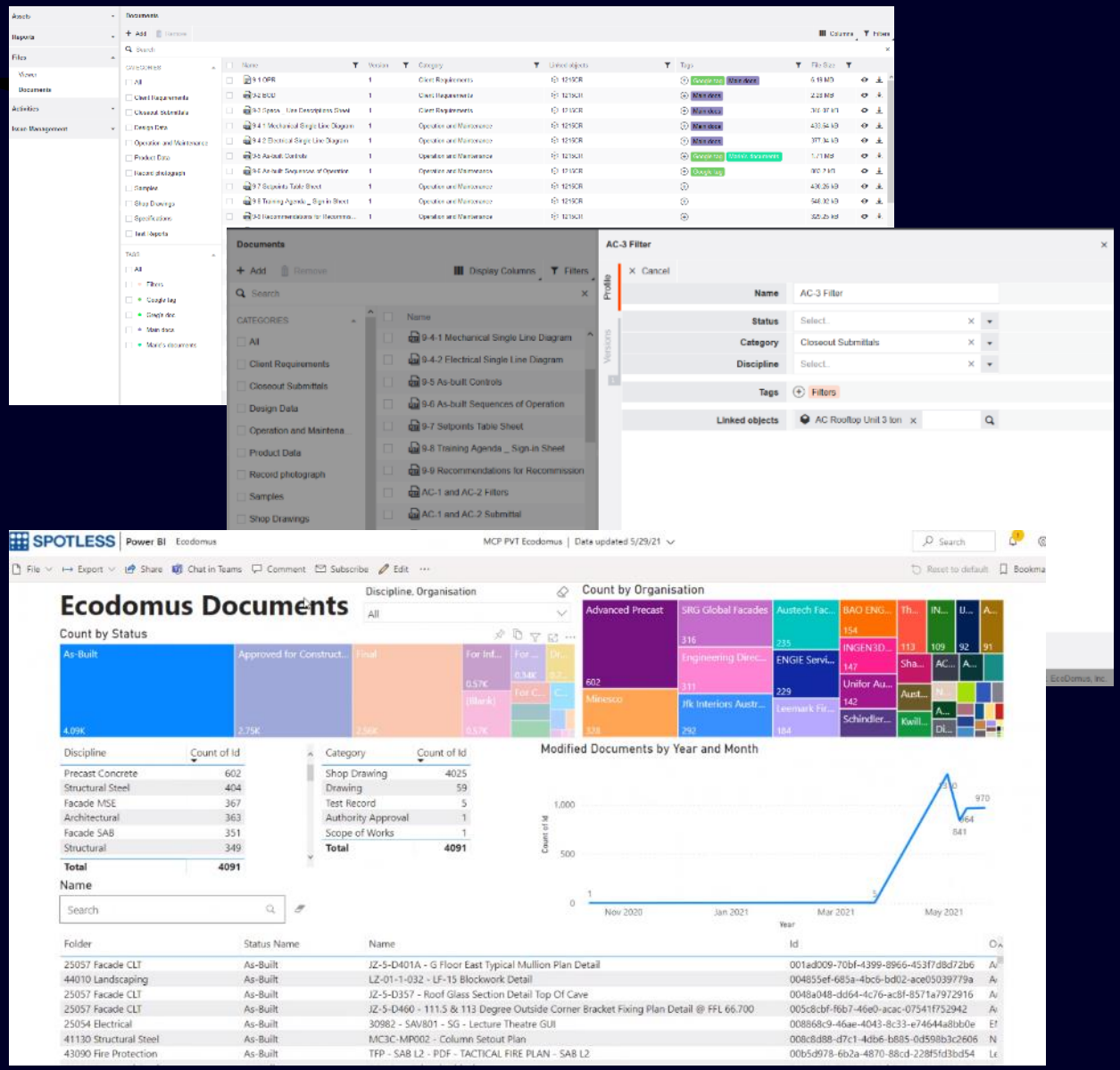
Ecodomus Document Management System

- Each file has metadata associated with it: Category, custom tags, version (revision), date updated, size, etc.
- Metadata fields are editable. Documents can be filtered by metadata fields
- Custom queries can be saved for reuse
- Docs are linked to BIM objects (i.e., component, type, space, system, etc)



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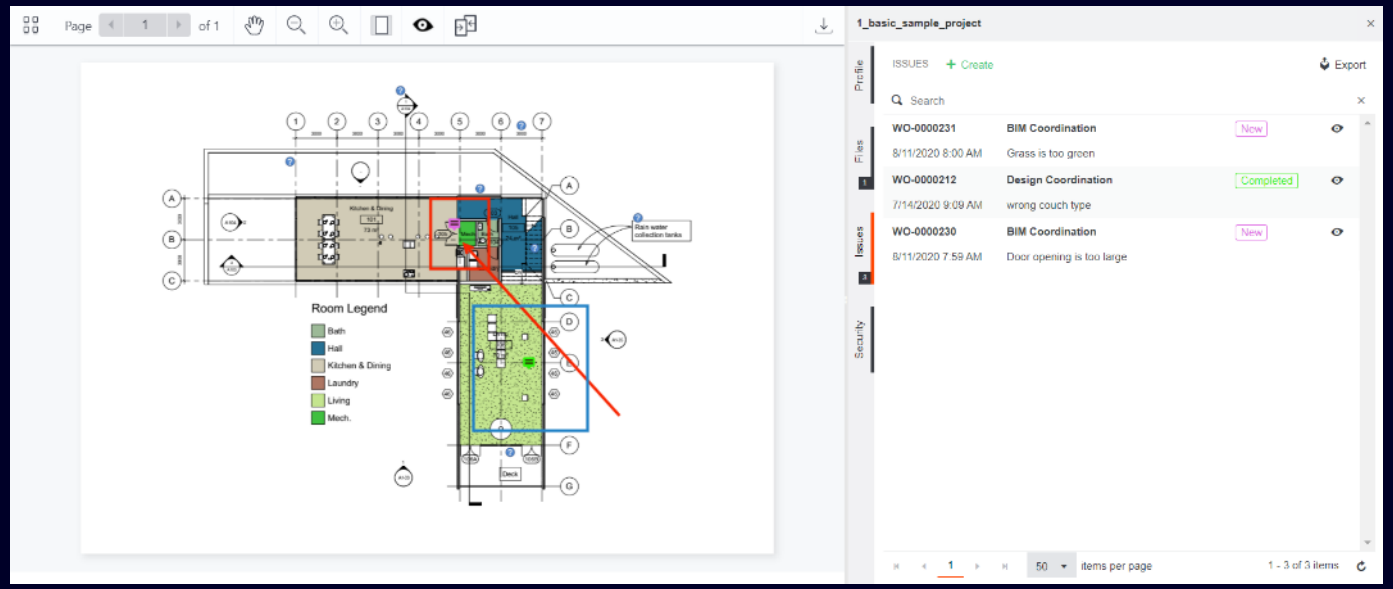
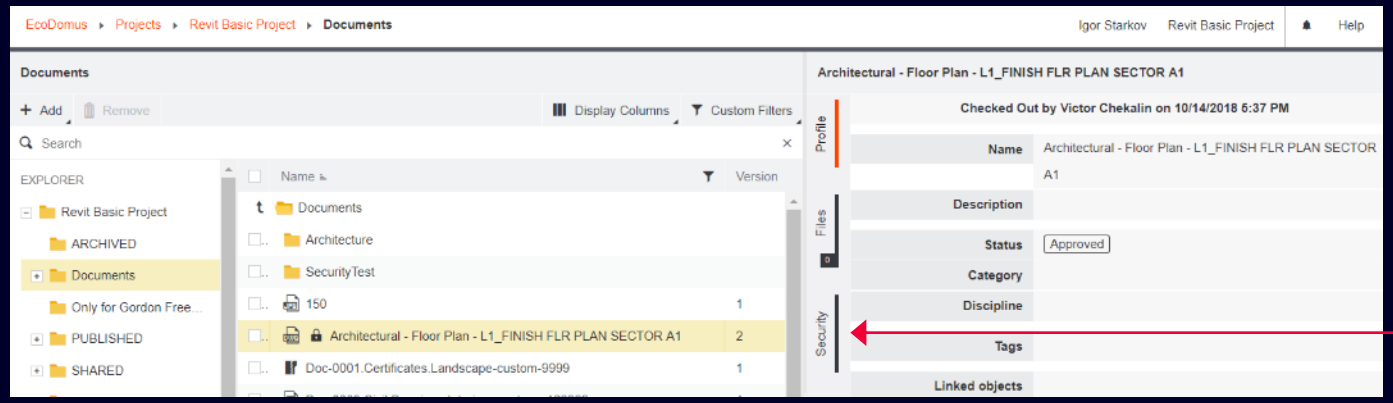
Ecodomus Document Management System



- Ability to redline and comment PDFs, DWGs, DGNs, and link to issues
- Multi-layering of markups with turn on/off function
- Support for multiple formatted files per document record



Check-in/Check-out locking of files for editing

Access rights (security) for files and folders

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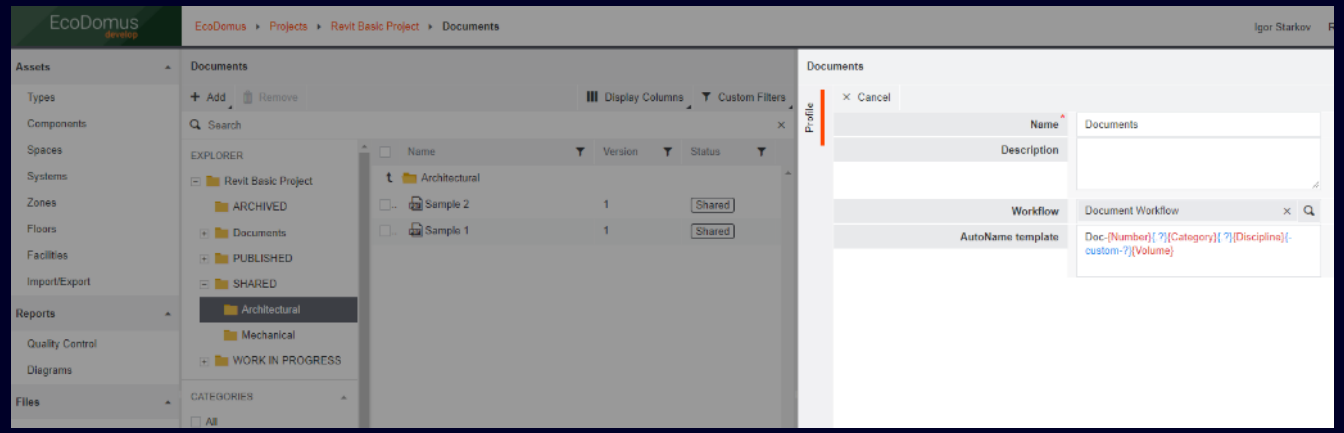
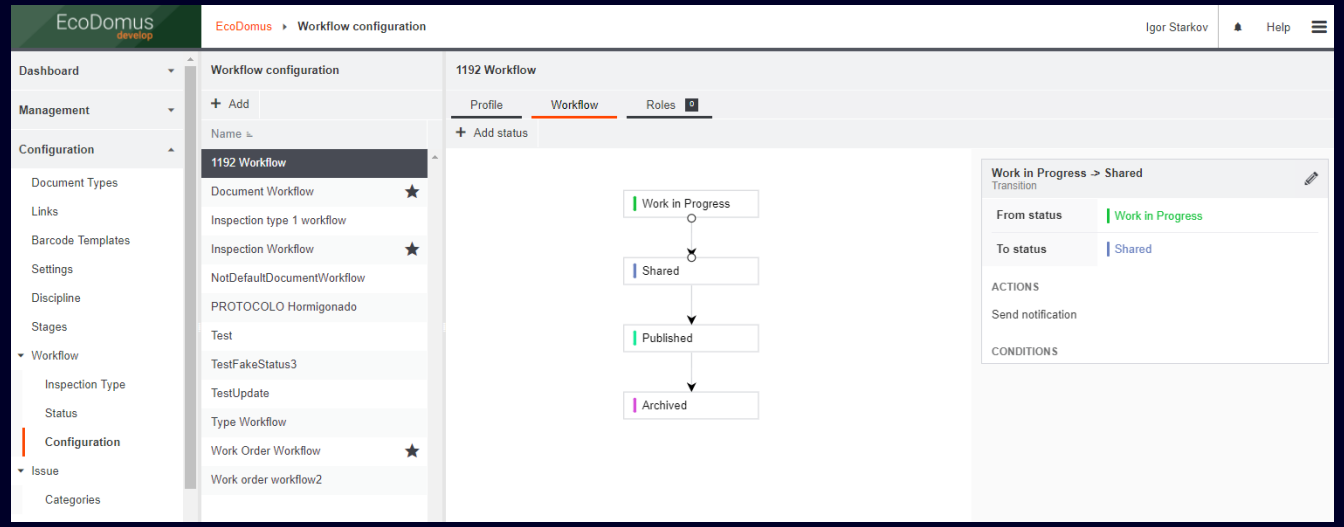
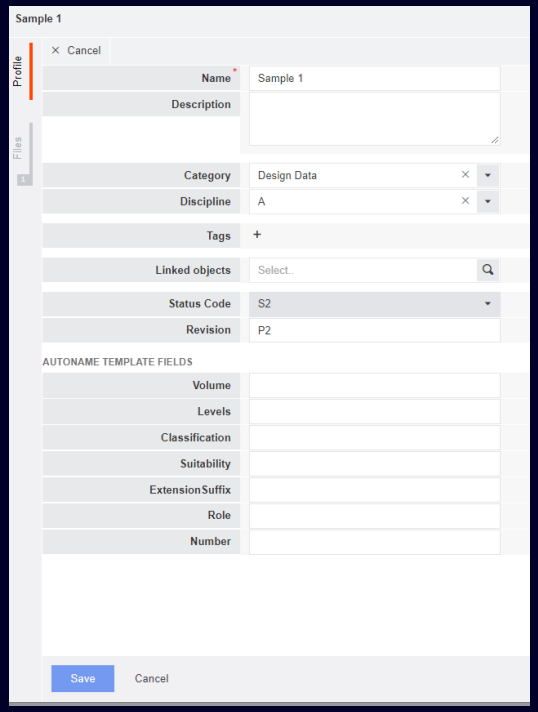
Customizable Workflows

CAD and BIM files can be stored in folders, and auto-renamed on upload using formulas.



Files' status can be changed according to workflows (i.e., **ISO 19650**), that admin users can customize using web interface.





Files' properties can be customized via a web interface. This helps to search/find files, link files to BIM objects (i.e. instance or type or system), edit files' status and revision.

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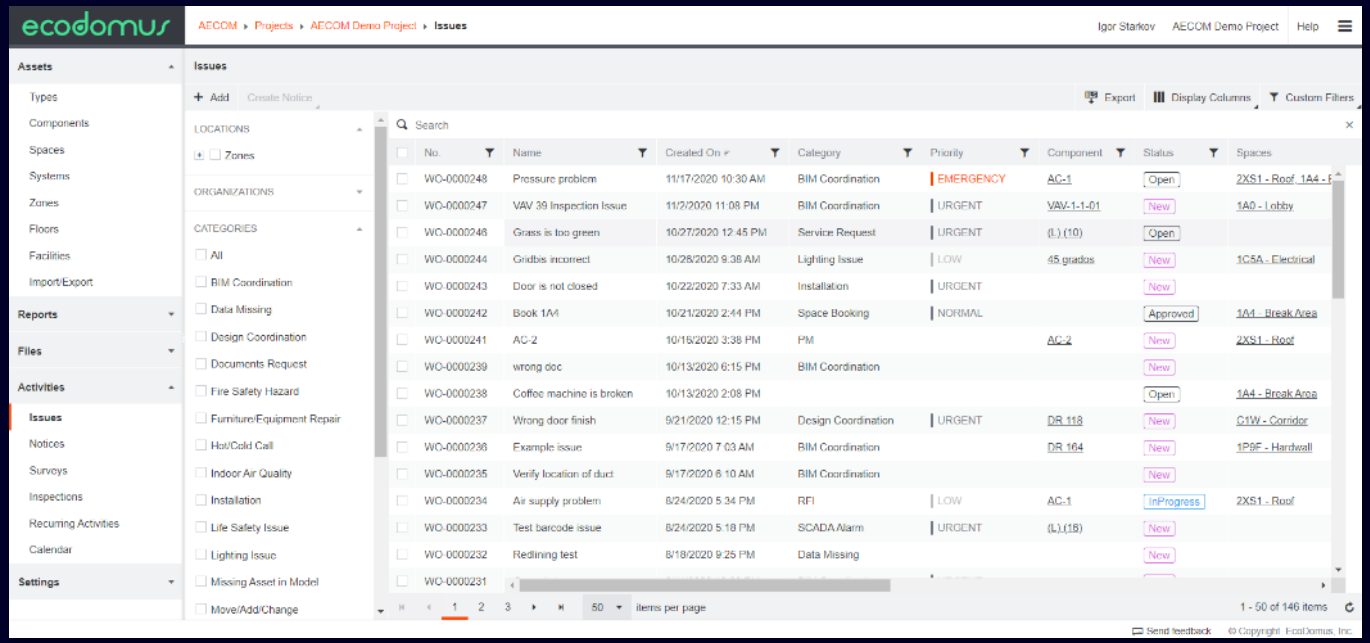
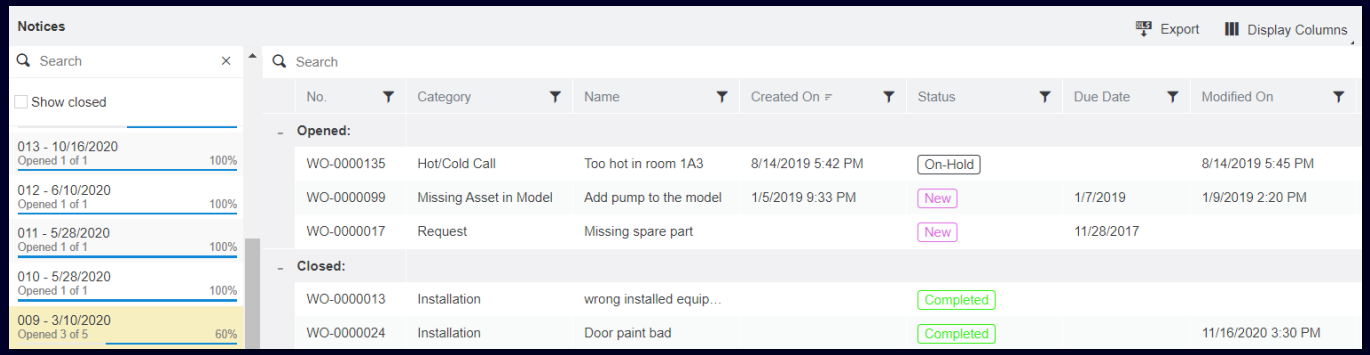
Ecodomus Tasks Management System

- Tasks (field issues, design coordination problems, work orders, RFIs, hot/cold calls, service requests, etc.) can be created via a web form, on a mobile device, or within a 3D viewer
- Various reports can be built and exported to Excel or to BI tools
- If Tasks are not properly addressed, users can create Notices, which can be used to generate a template-based PDF documents sent to the responsible party





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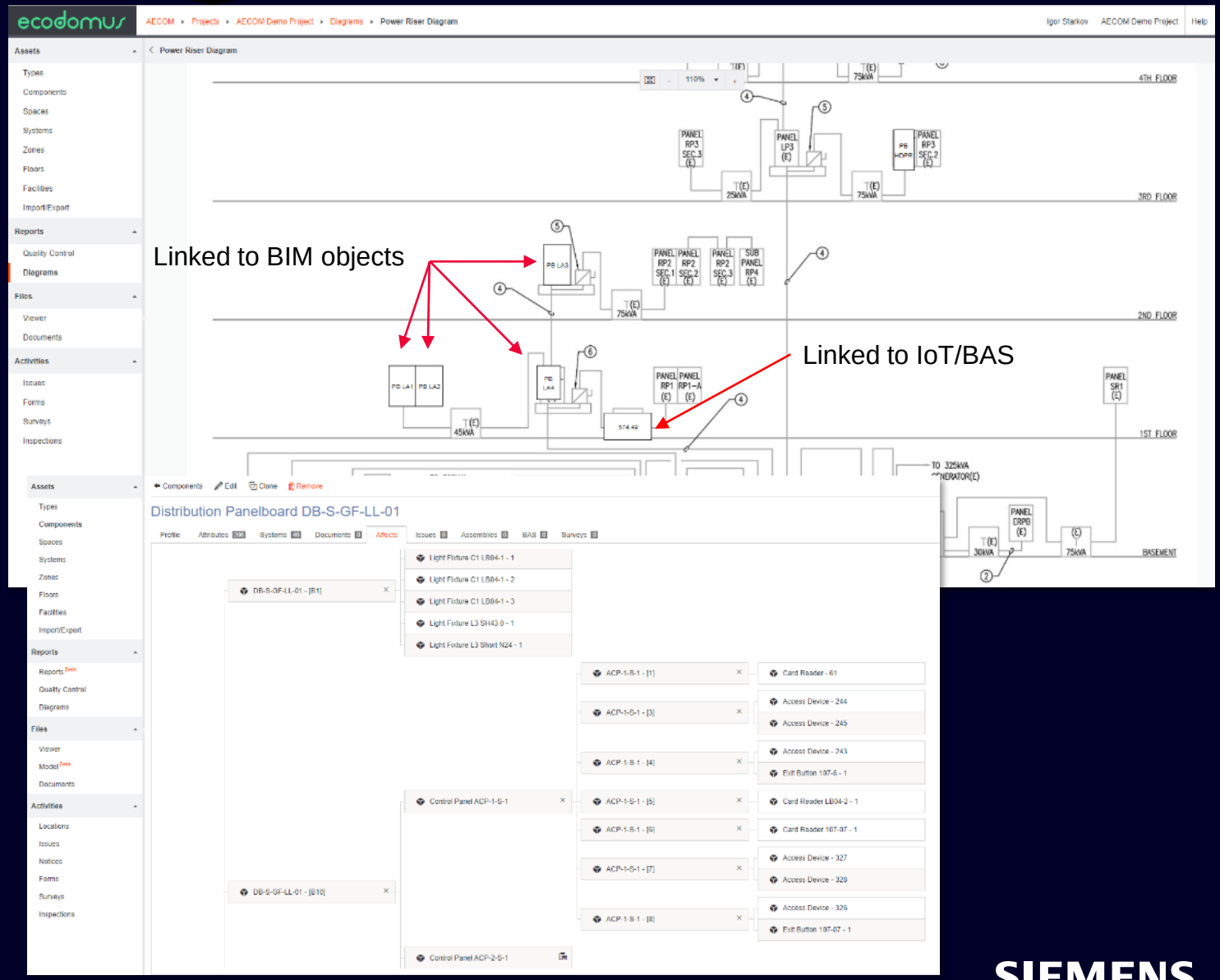
2D Interface as a Valuable Addition to 3D

- Every element of the 2D electrical diagram on the left can be linked to a BIM object or show real-time data from a sensor
- The “affects” schema below shows relationships between the elements of the electrical system



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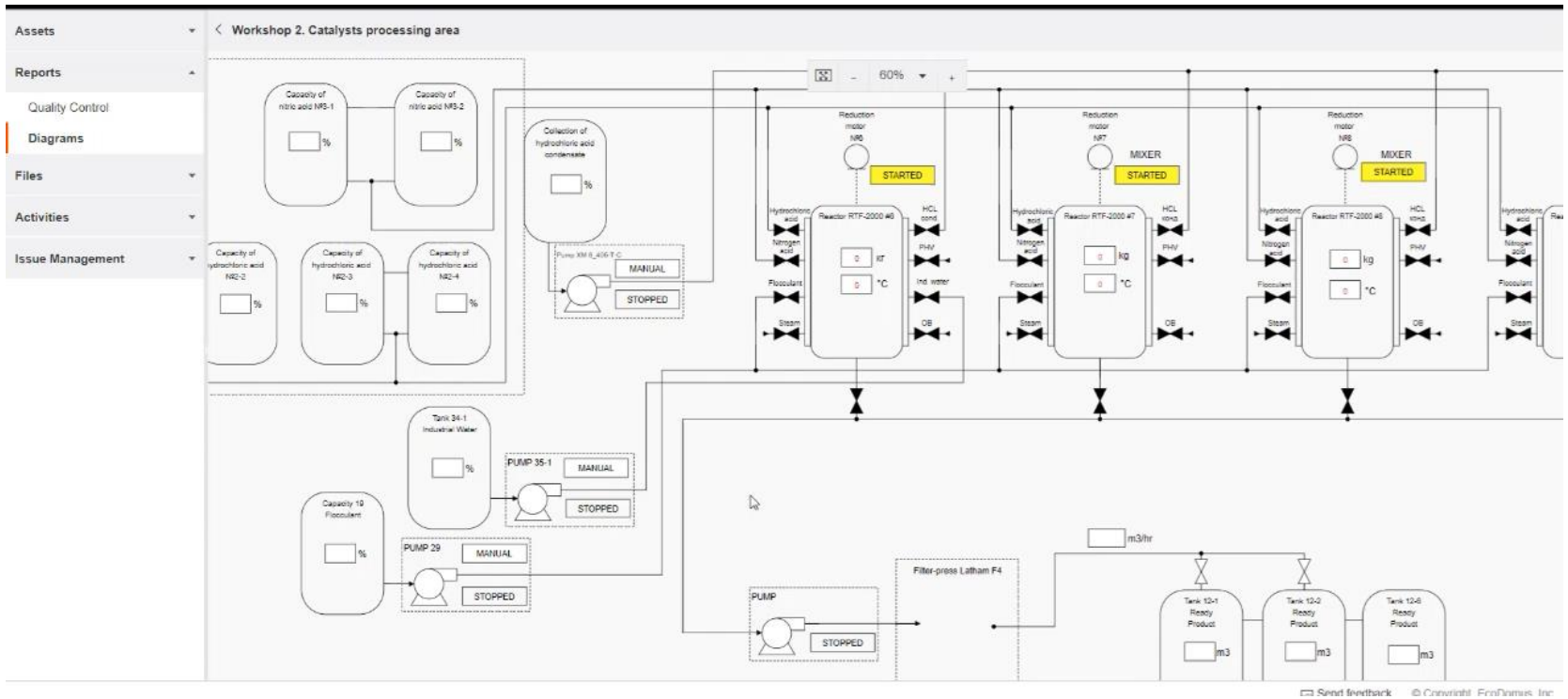
Ecodomus Diagrams: Connect 2D & 3D & IoT



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BIM and Project Management Integration

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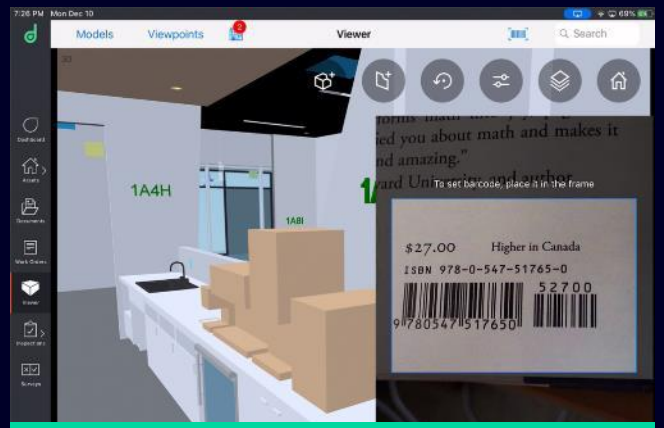
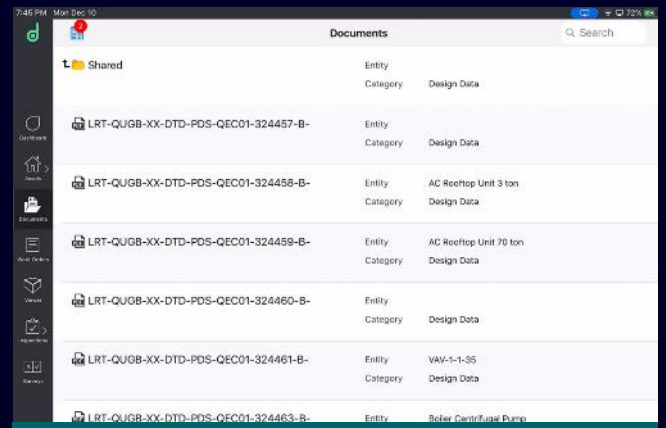
Mobile BIM and Quality Control on iPad

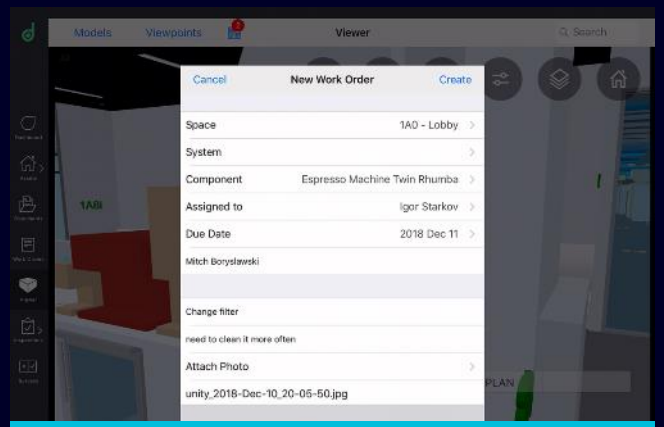


Scan QR/Barcodes or Use RFID

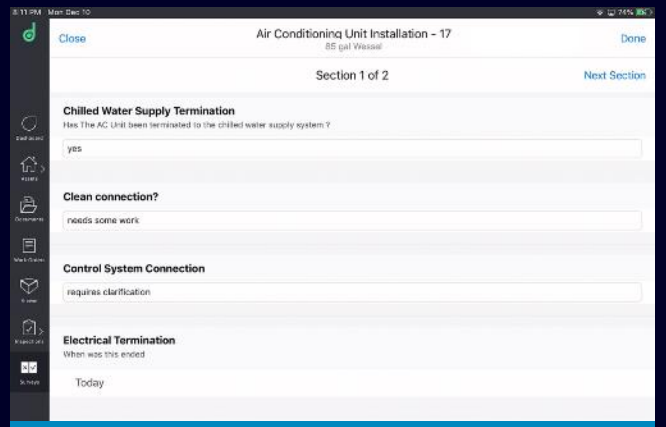
Find Assets & View Attributes



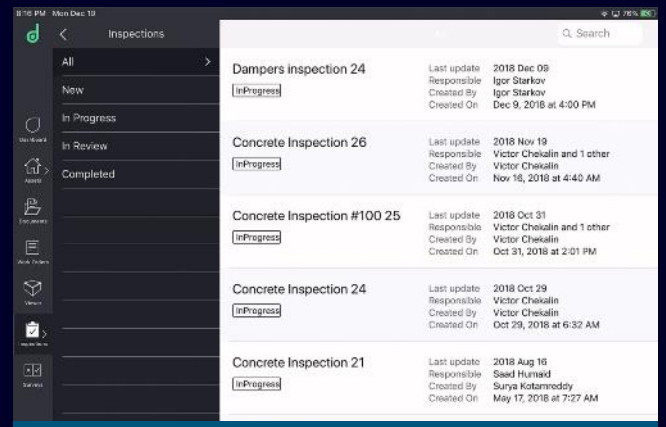
Review & Markup Documents



Manage Issues



Fill Out Forms



Complete Inspections

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Mobile Inspections, Documents, Forms

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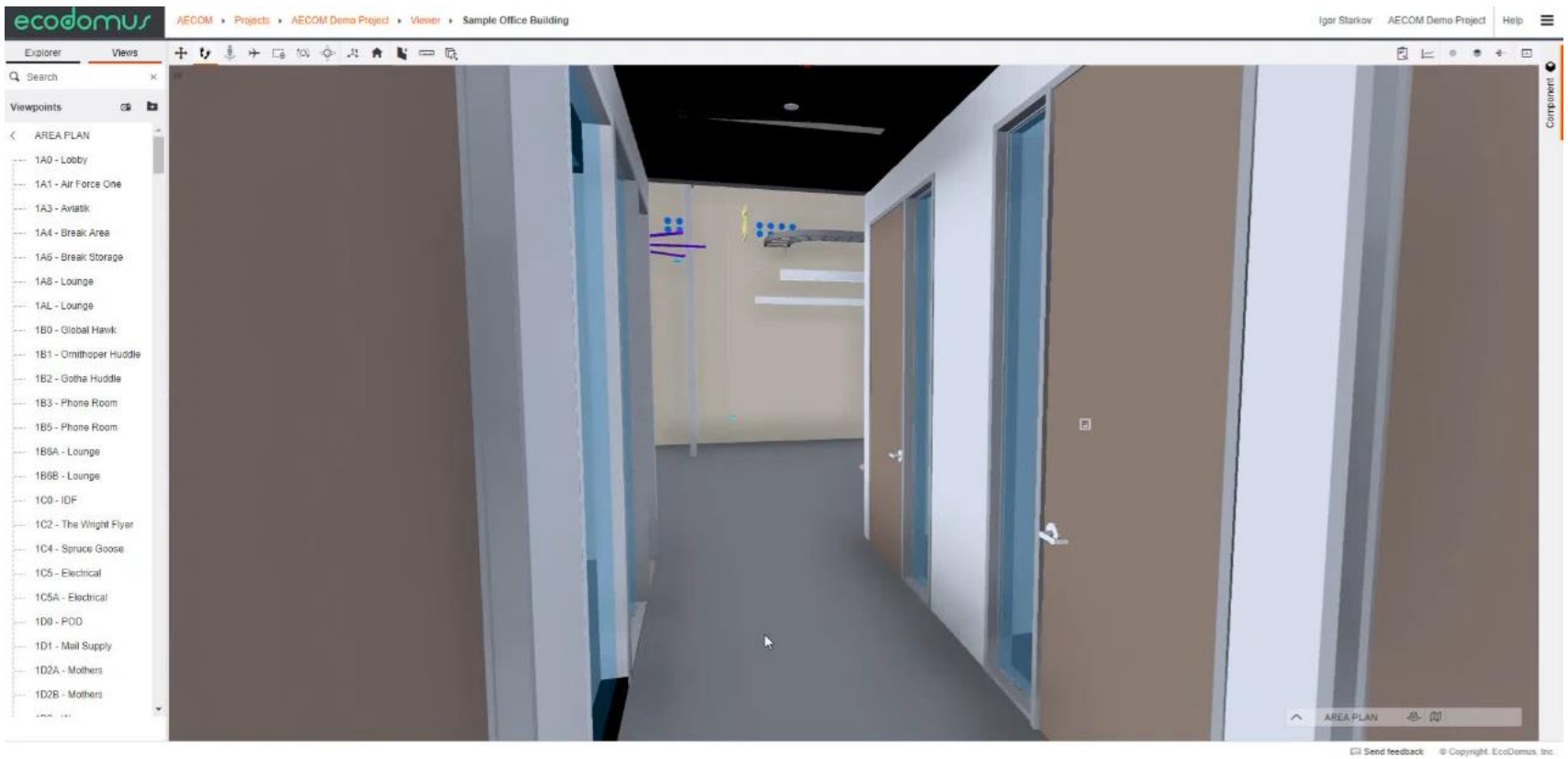
Issues Management in 3D BIM & Point Cloud



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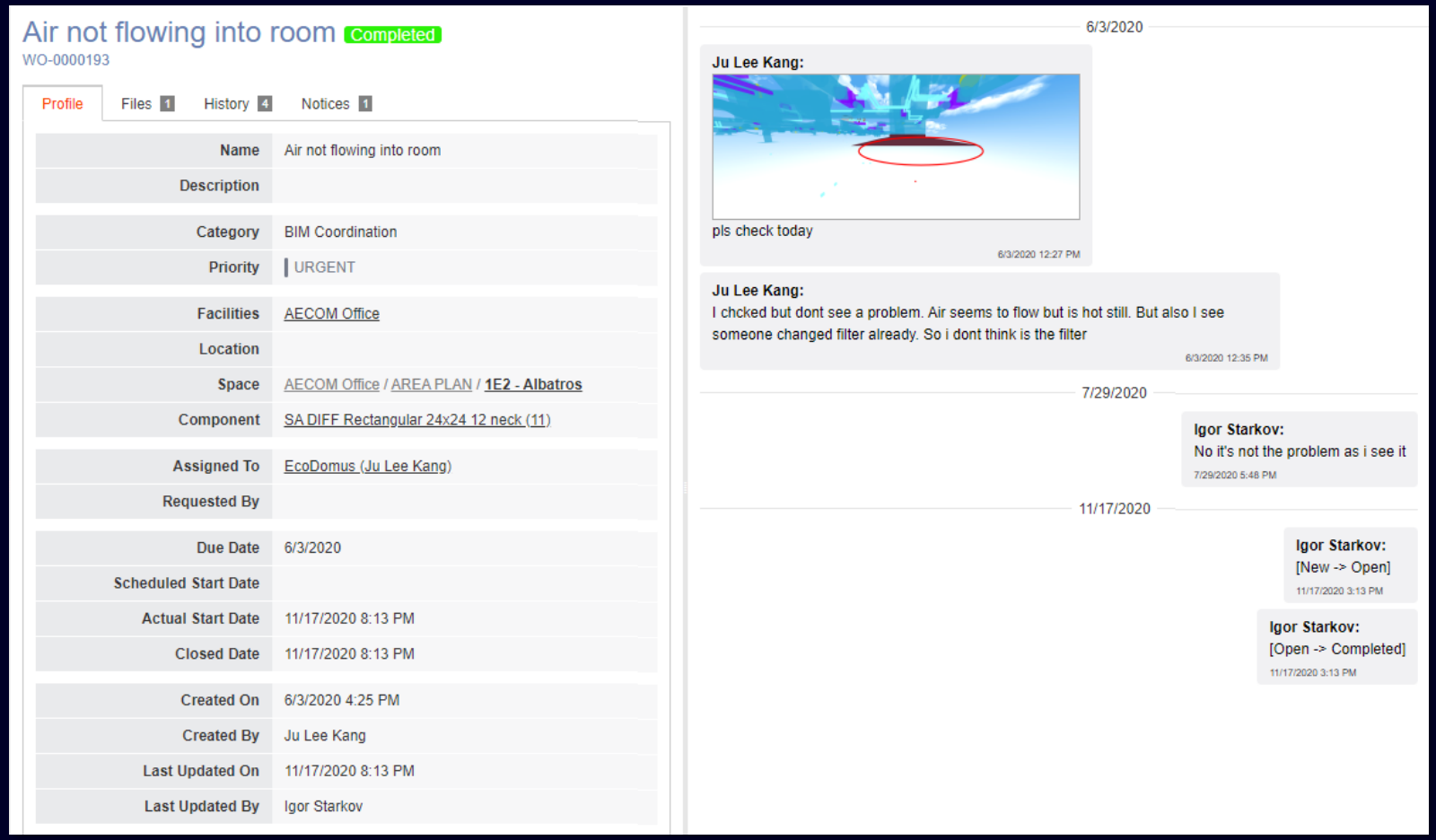
Issues Activity History

- A chat-like window on the right of issue's profile allows tracking all activities related to an issue and collaborate with your colleagues in real-time
- Issue status changes are reflected in the Activity window
- Images (from 3D viewer, photos taken on mobile devices, etc.) are attached to the issue and shown in the Activity window



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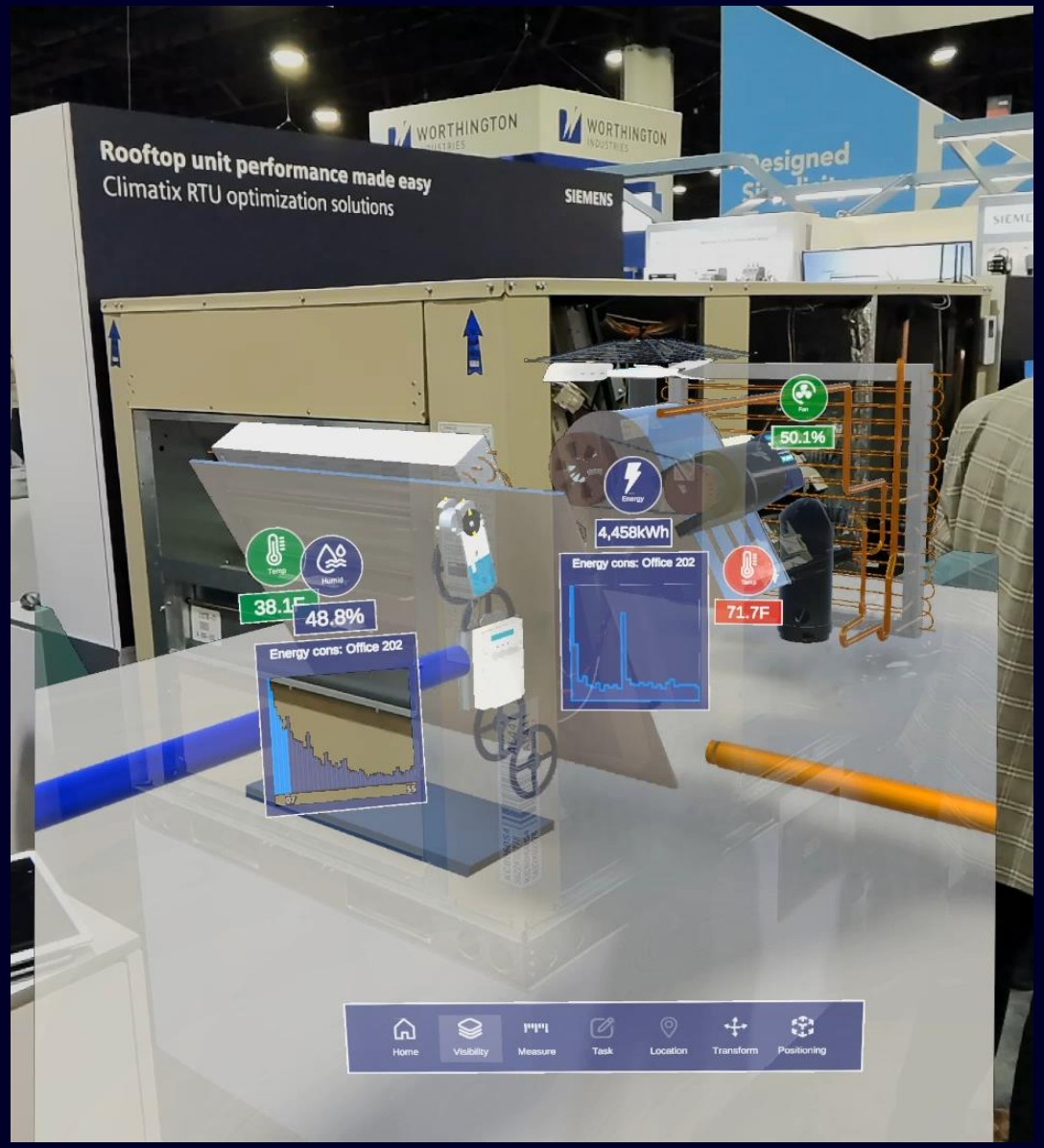
Augmented & Mixed Reality Interface



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Agenda

Section 1	About Ecodomus
Section 2	Digital Twins and BIM CDE and why it is critical for design, construction and facility management
Section 3	Standards for Project Information Model (PIM), QC and Asset Information Model (AIM)
Section 4	Supporting 2D workflows while upgrading to BIM
Section 5	Integrating BIM with PM, CMMS, CAFM, ERP
Section 6	Mobile BIM and AR/MR (inspections, issues, electronic forms)
Section 7	BIM + Internet of Things (IoT) for optimal building performance
Section 8	Laser scanning technology for 3D asset management
Questions and Answers	

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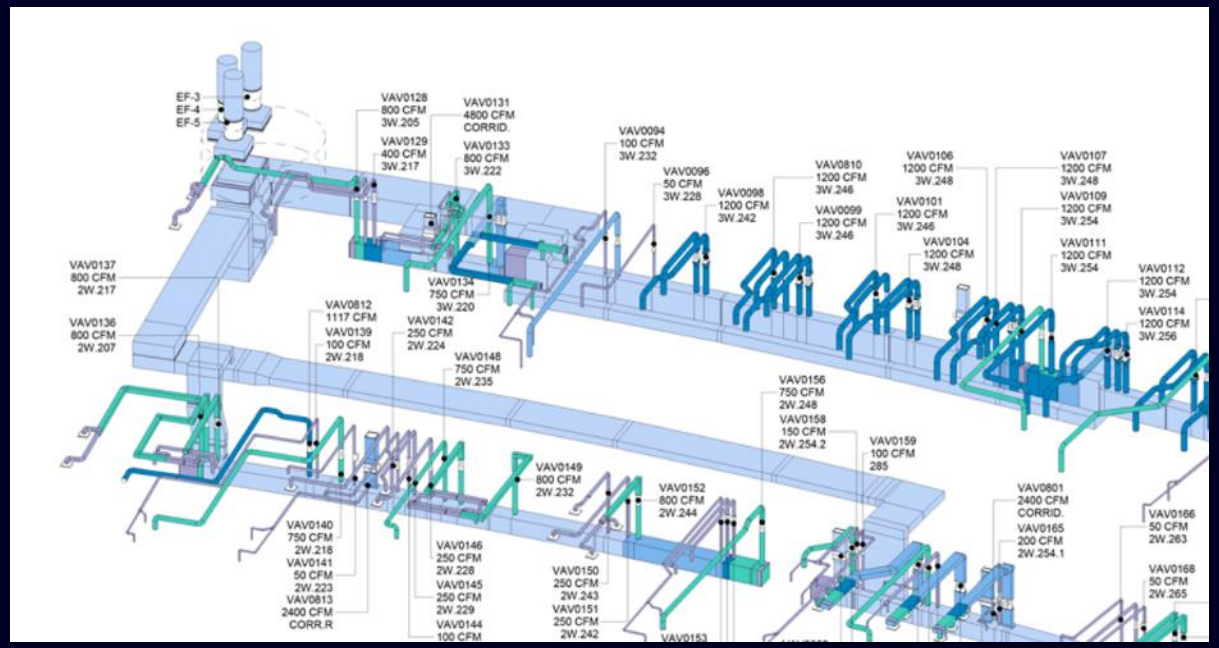
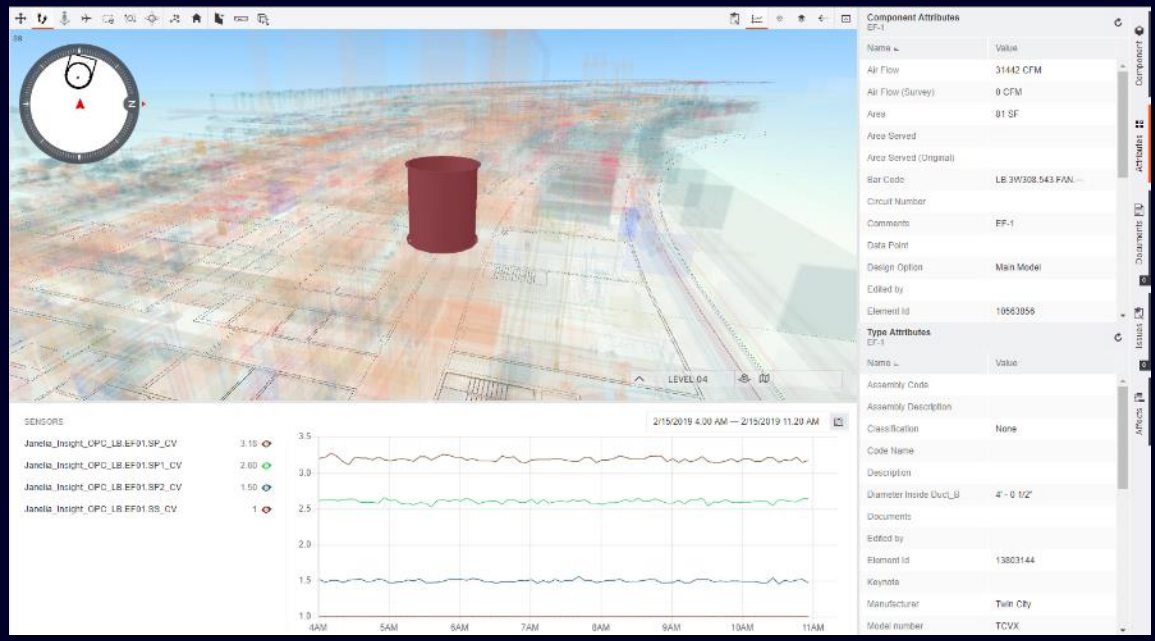
Using BIM/BAS Integration for Analytics

We get “as designed” (intent) BIM from architects/engineers and “as built” values from builders and commissioning agents, and link sensors’ data to objects to see how close the actual values “as operated” are compared to the “design intent” and “as built”.

As Designed/As Built



As Operated



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BIM and SCADA/ BAS Integration

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Case Study: Creating Digital Twin for Existing Facility

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BIM and GIS Integration

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Questions and Answers

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Contact

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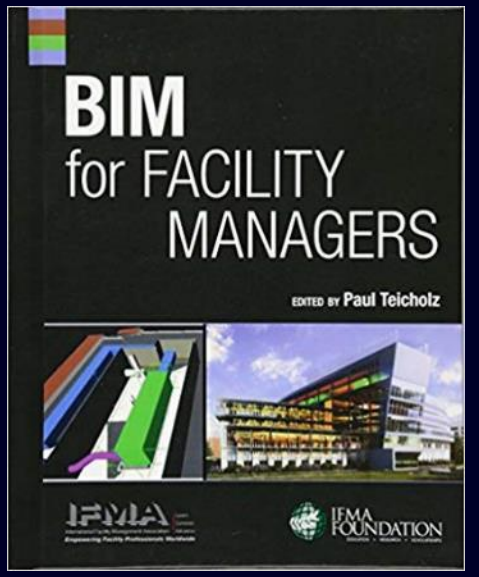
Read about Ecodomus:

#1 book on BIM in the industry.
3 out of 11 case studies are from Ecodomus projects:
Howard Hughes Medical, Stanford, Medina Airport



Ecodomus is the only software with a dedicated chapter.
The image on the cover is from our USC project.

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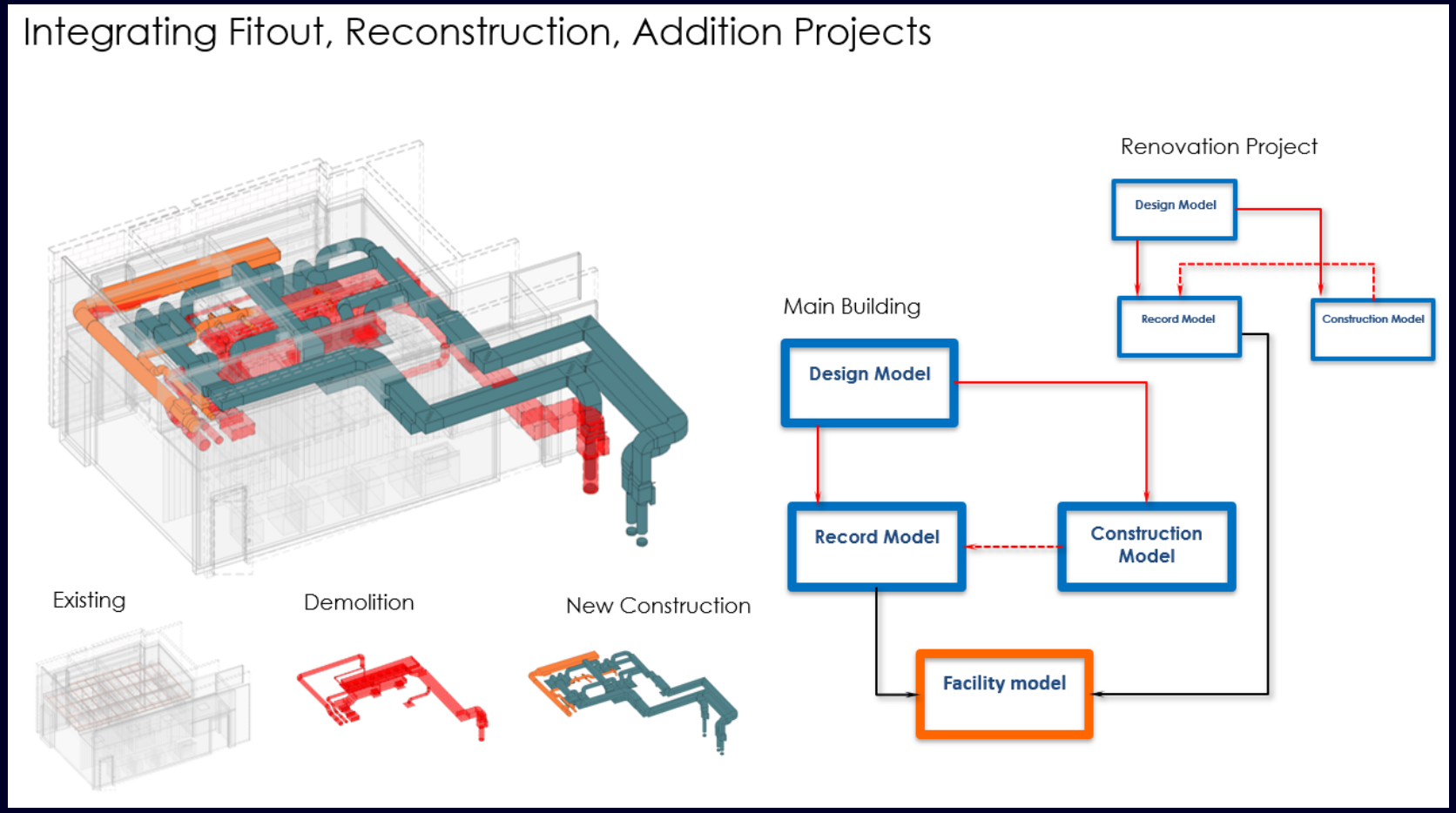
How to Create Facility Model for Digital Twin



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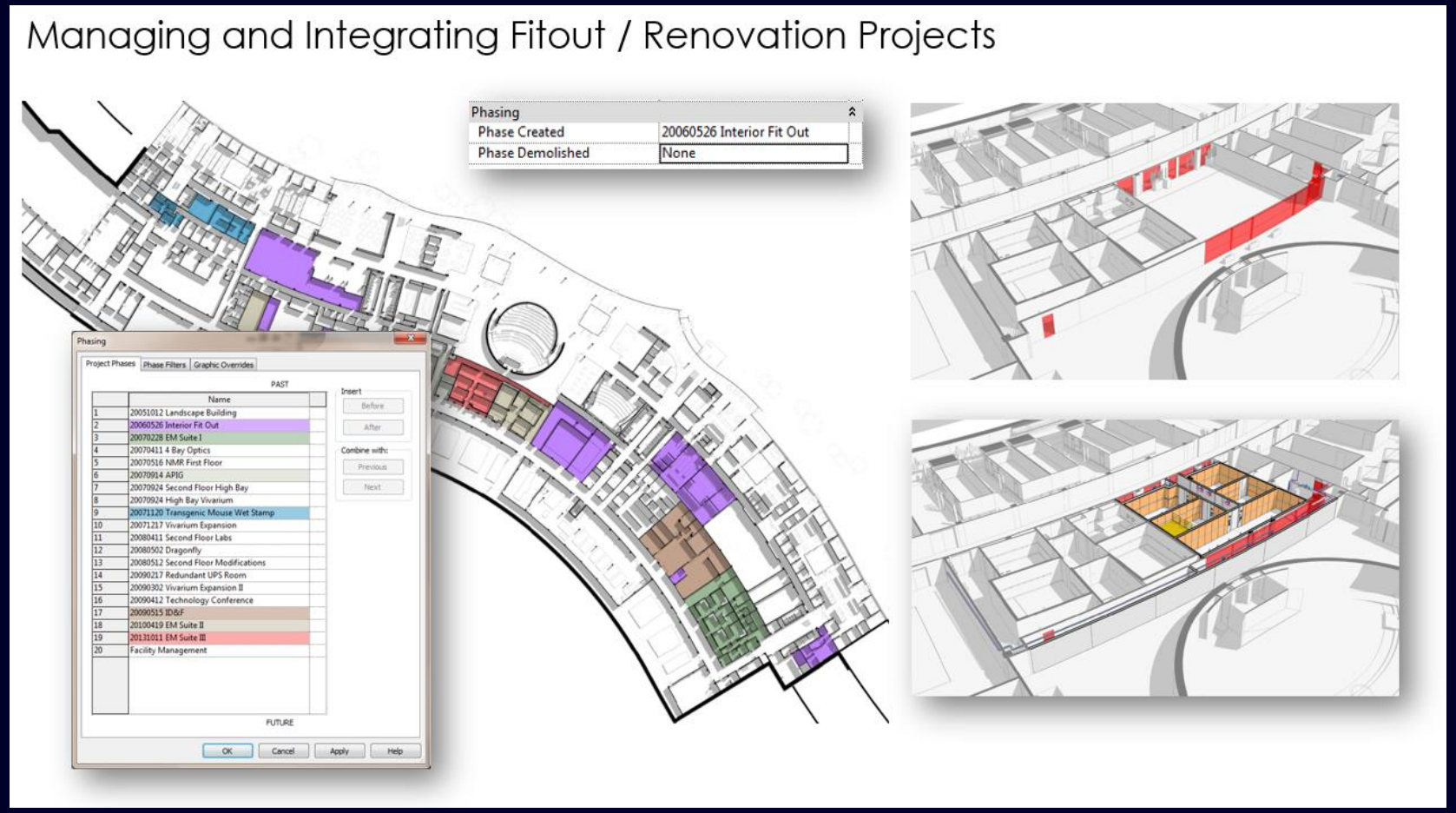
How to Maintain Digital Twins

All renovation projects are managed using phases in Revit and provide ability to review what changed (“before” and “after” views).



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