

# BIM-Based Generation of Multi-Model Views

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# Outline

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- I. Motivation - Why
- II. Methodology – Who, When and How
- III. Technological Approach – In What Way (Demo)
- IV. Conclusions

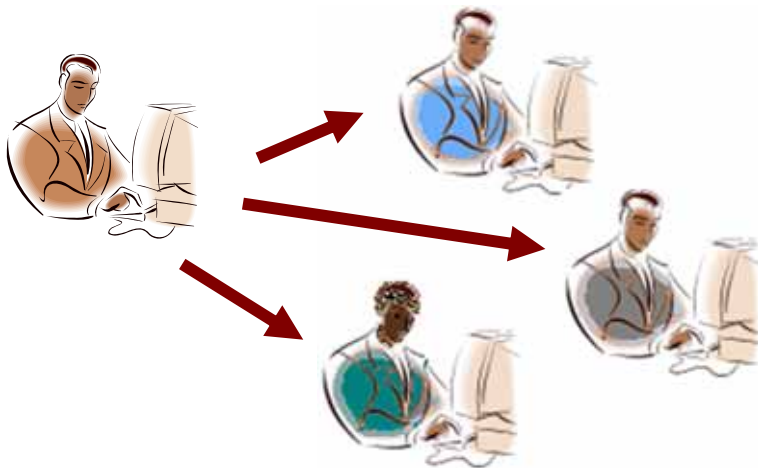


# Motivation: Why BIM-based Multi-Model Views

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## Architectural BIM ( Coordination View )

*Design cooperation  
Further needed data are  
mainly document based*



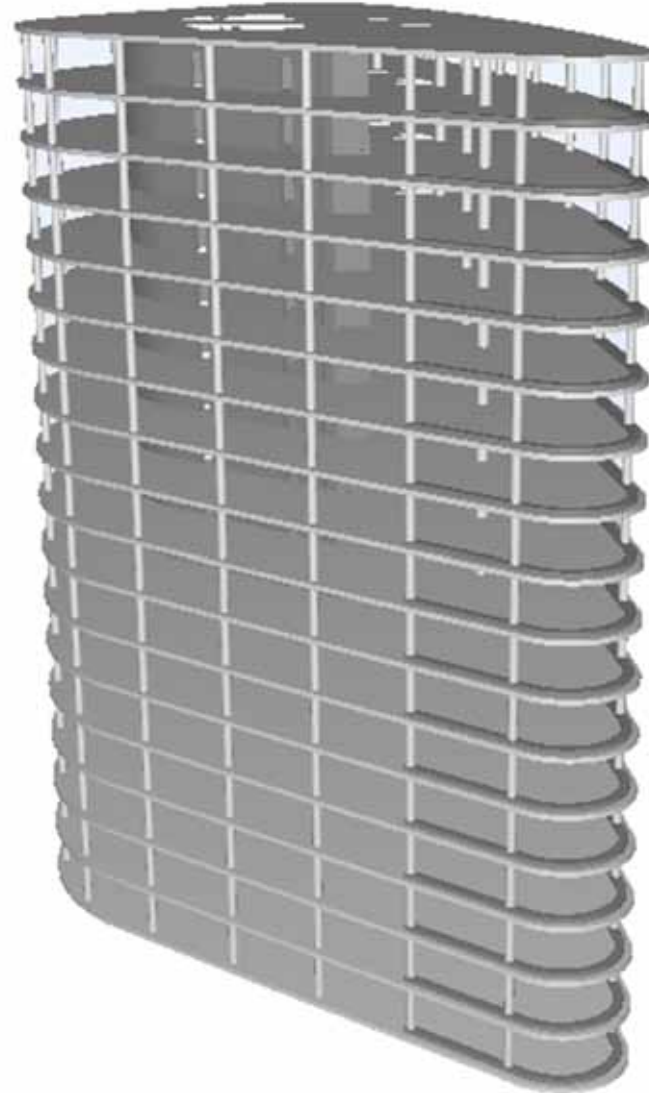
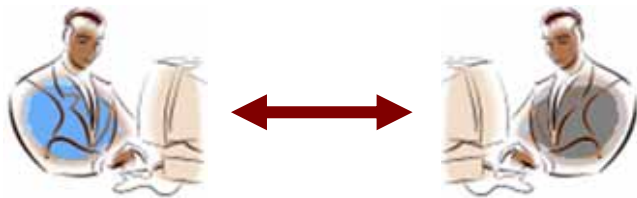


# Motivation: Why BIM-based Multi-Model Views

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## Structural View

*Further needed data:  
loads, environment ...*

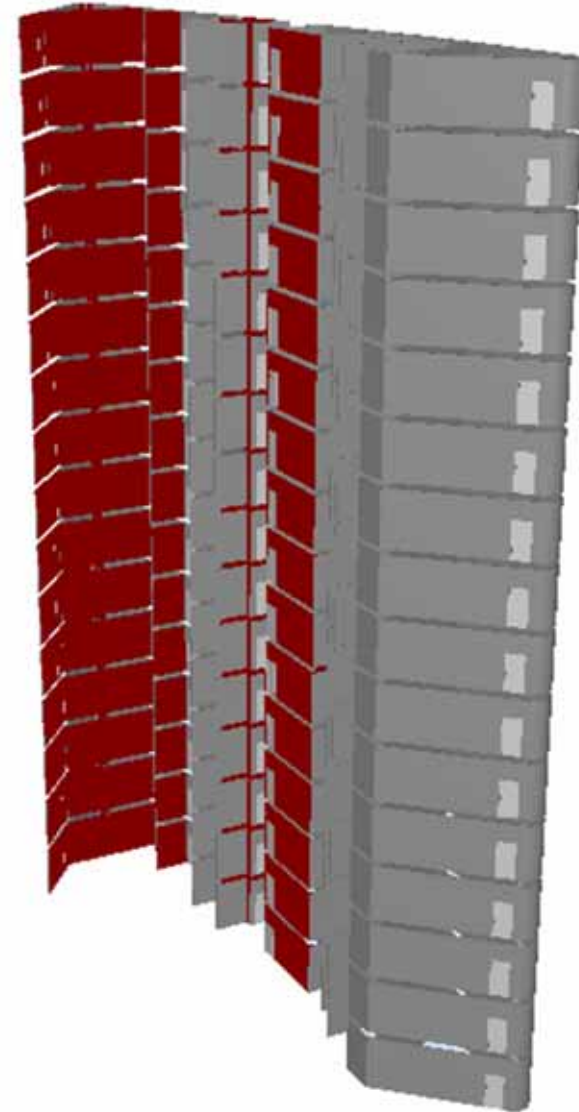
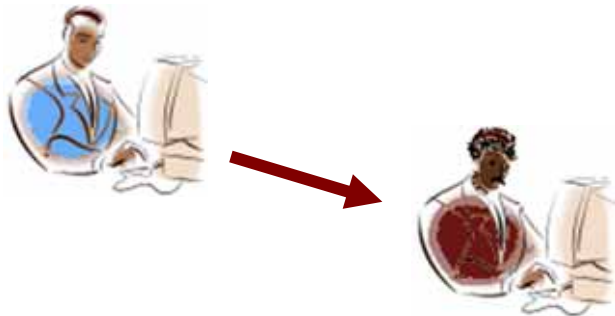




# Motivation: Why BIM-based Multi-Model Views

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Filtered Structural View  
(shear walls for lateral stiffness)  
- suitable for FE Analysis -



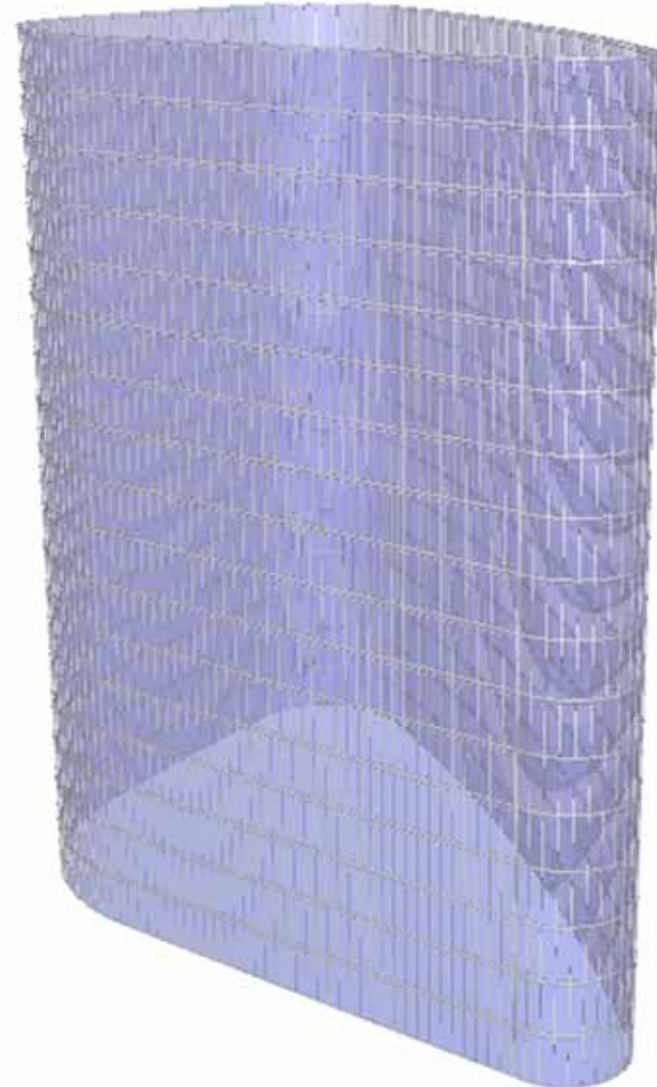
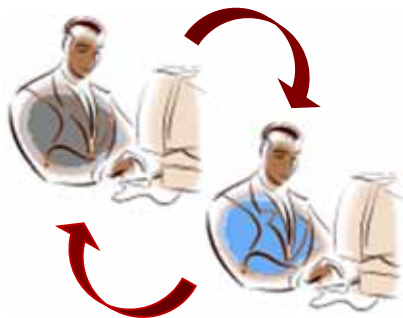


# Motivation: Why BIM-based Multi-Model Views

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## Filtered Building Envelope (facades) View

*Further needed data:  
Environment, Climate,  
Data from sensors and actuators  
(Building Automation)*



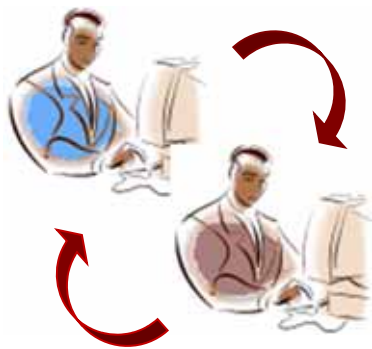


# Motivation: Why BIM-based Multi-Model Views

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## Fluid dynamics model

*Further needed data:  
Wind model data,  
Detailed material/finishing data*







# Motivation: Why BIM-based Multi-Model Views

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Fluid dynamics model

etc. etc. ... ..







# Motivation: Why BIM-based Multi-Model Views

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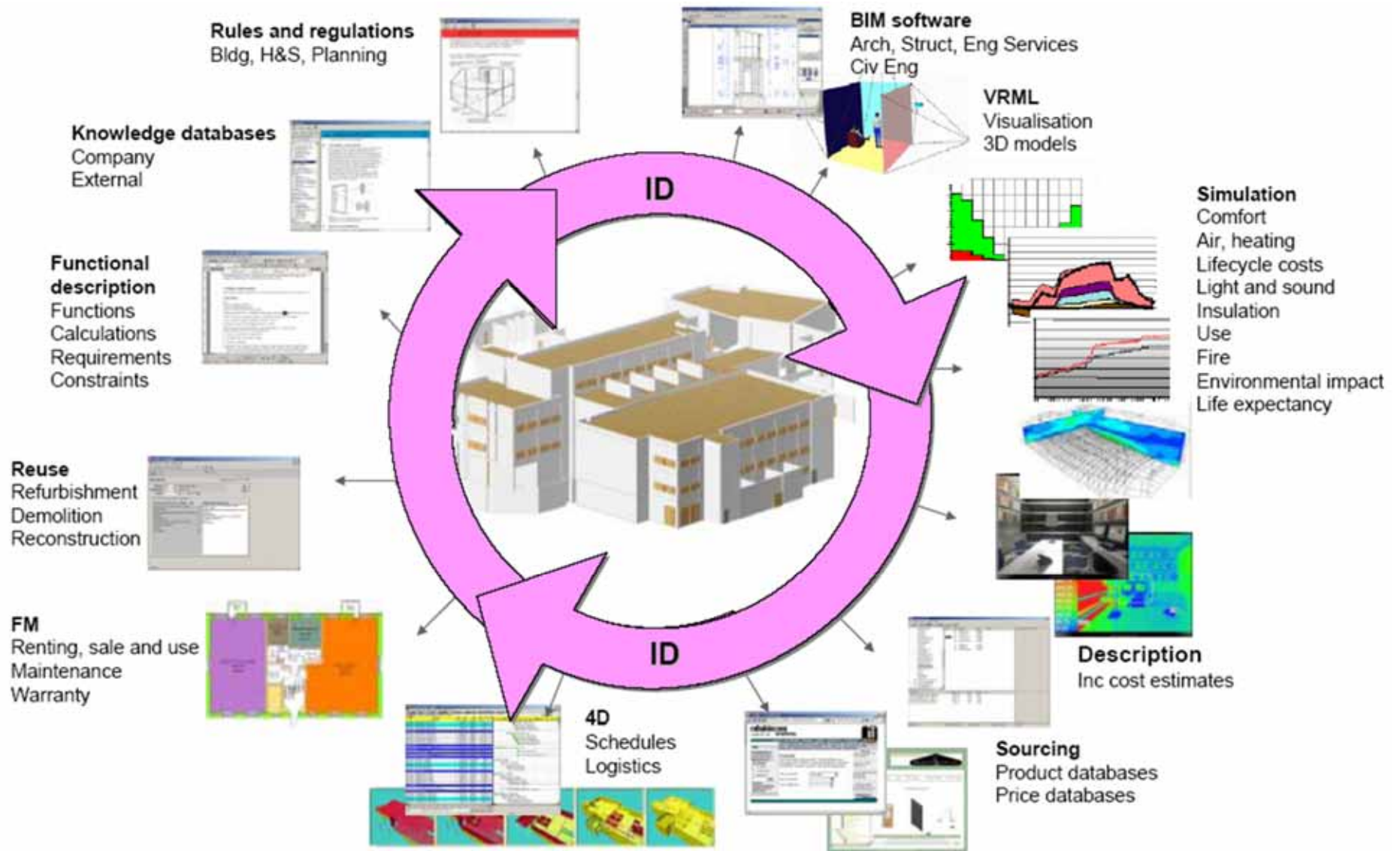
- Individual design/construction domains require their own view of BIM
- Such views are typically subsets of the full BIM, but augmented with domain-specific model data
- People use BIM with different tools and in different ways
- In order to support their work, these tools need to be adapted to the specific user requirements and "speak" the specific user language
- However, unlike large CAD vendors, specialized AEC software developers often find it too difficult to work with the full IFC model

→ **Key: Multi-Model Views**



# The Vision of Interoperability in AEC

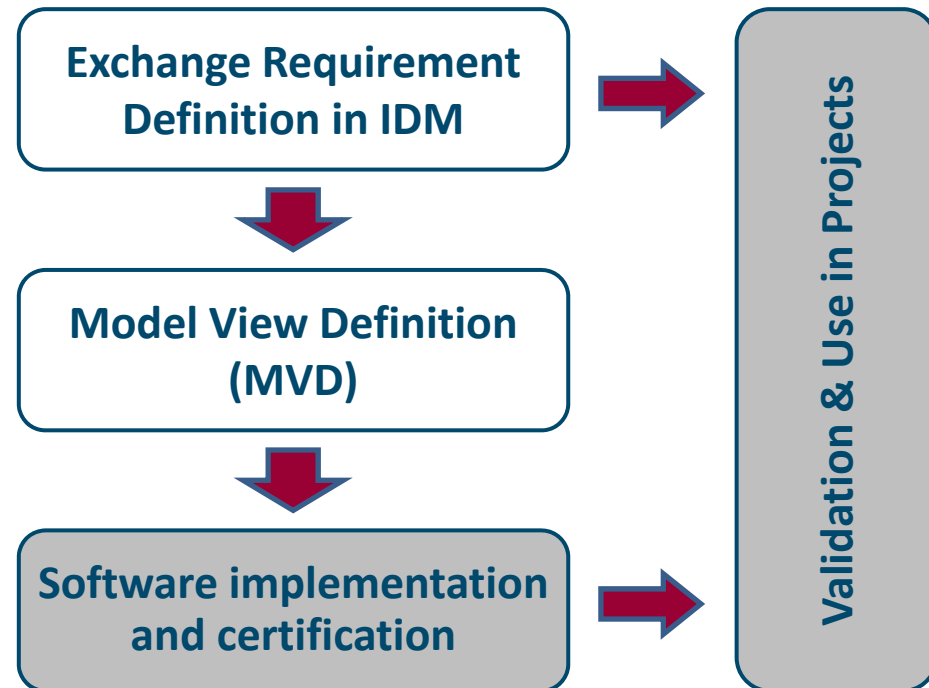
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# Methodology: The "classical" IDM/MVD Approach

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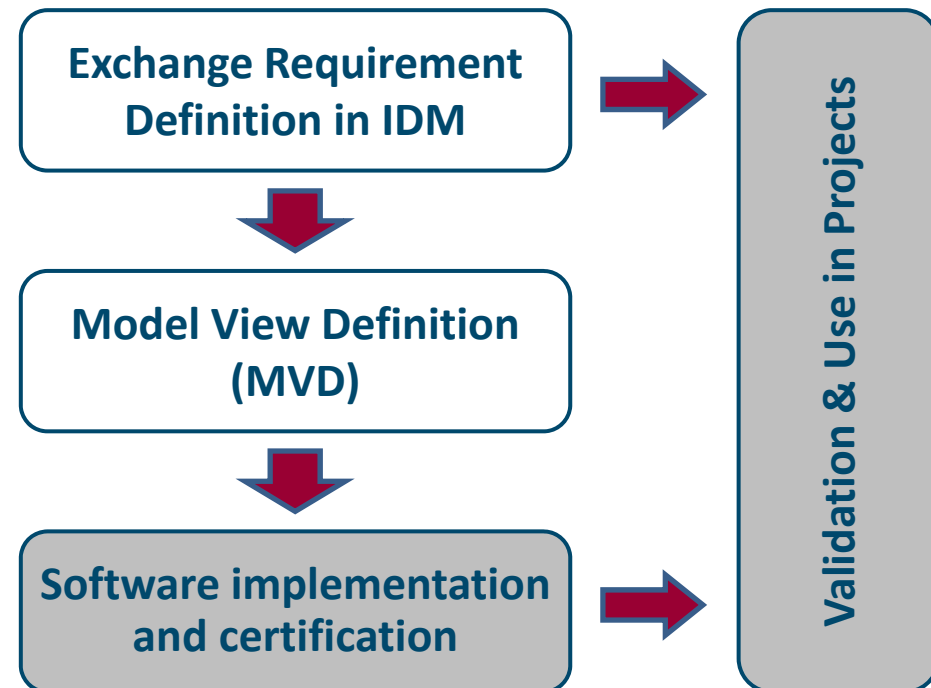
# Methodology: The "classical" IDM/MVD Approach

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## Problems:

IDM / MVD answers quite well the question of "Why" and "How" but it does not completely resolve "Who", "When" and "in what way" should define, implement and use BIM views.

It also doesn't give answer to questions related to multi-model views





# Methodology: Suggested Enhanced Approach

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## Support Tools on three levels

### I. Modelers

Subschema  
generator

### II. S/W Developers

Stand-alone or embedded  
multi-model view generator

### III. Developers & Users

Web-based or embedded  
object selection service

Exchange Requirement  
Definition in IDM

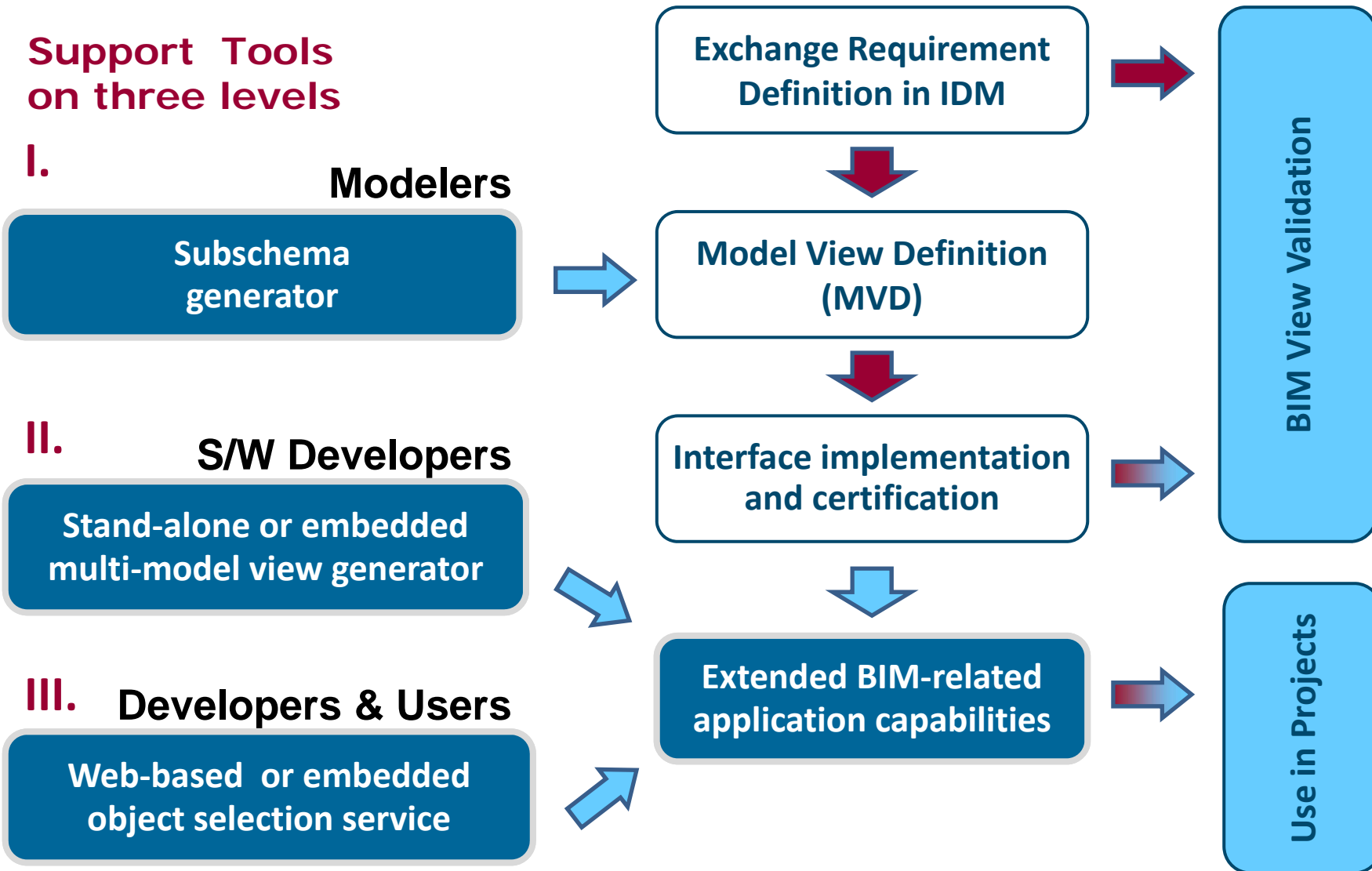
Model View Definition  
(MVD)

Interface implementation  
and certification

Extended BIM-related  
application capabilities

BIM View Validation

Use in Projects





# Supporting Tools

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- **View Edit**
  - ▶ Subschema / View Generation
  - ▶ Language: Java
  - ▶ Authors: TU Dresden, Germany & AEC3 Ltd. UK
  - ▶ Intended users: Modelers
- **OpenIcTools** ([www.openifctools.org](http://www.openifctools.org))
  - ▶ IfcViewer, inspector & library for IFC data manipulation in memory
  - ▶ Language: Java (Eclipse platform)
  - ▶ Authors: University of Weimar & Hochtief AG, Germany
- **Multi-Model Framework**
  - ▶ Multi-model view generation and refinement, Multi-model querying and data selection, Flexible addition of filtering mechanisms via plug-ins
  - ▶ Authors: TU Dresden, Germany
  - ▶ Intended users: Software developers (SMEs), End users

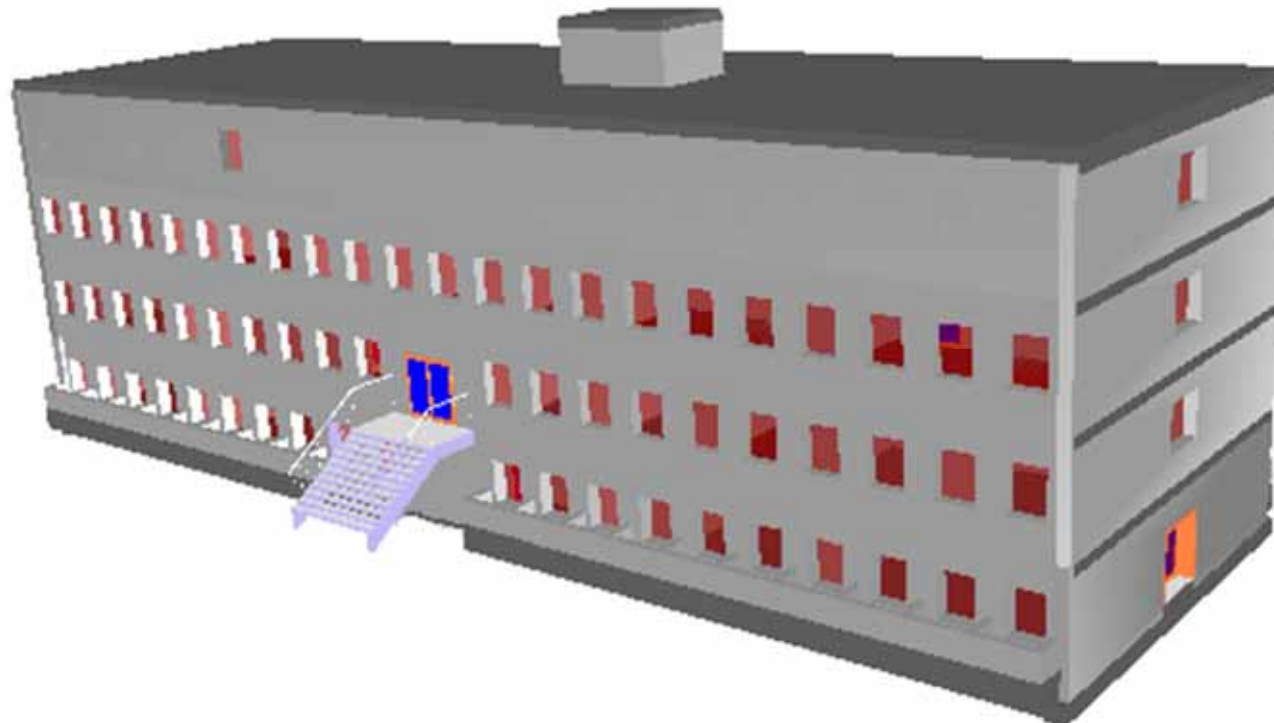


# Technological Approach

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## Case Example



Scenario:

Integrating BIM with data from temperature and humidity sensors for room climate calculations

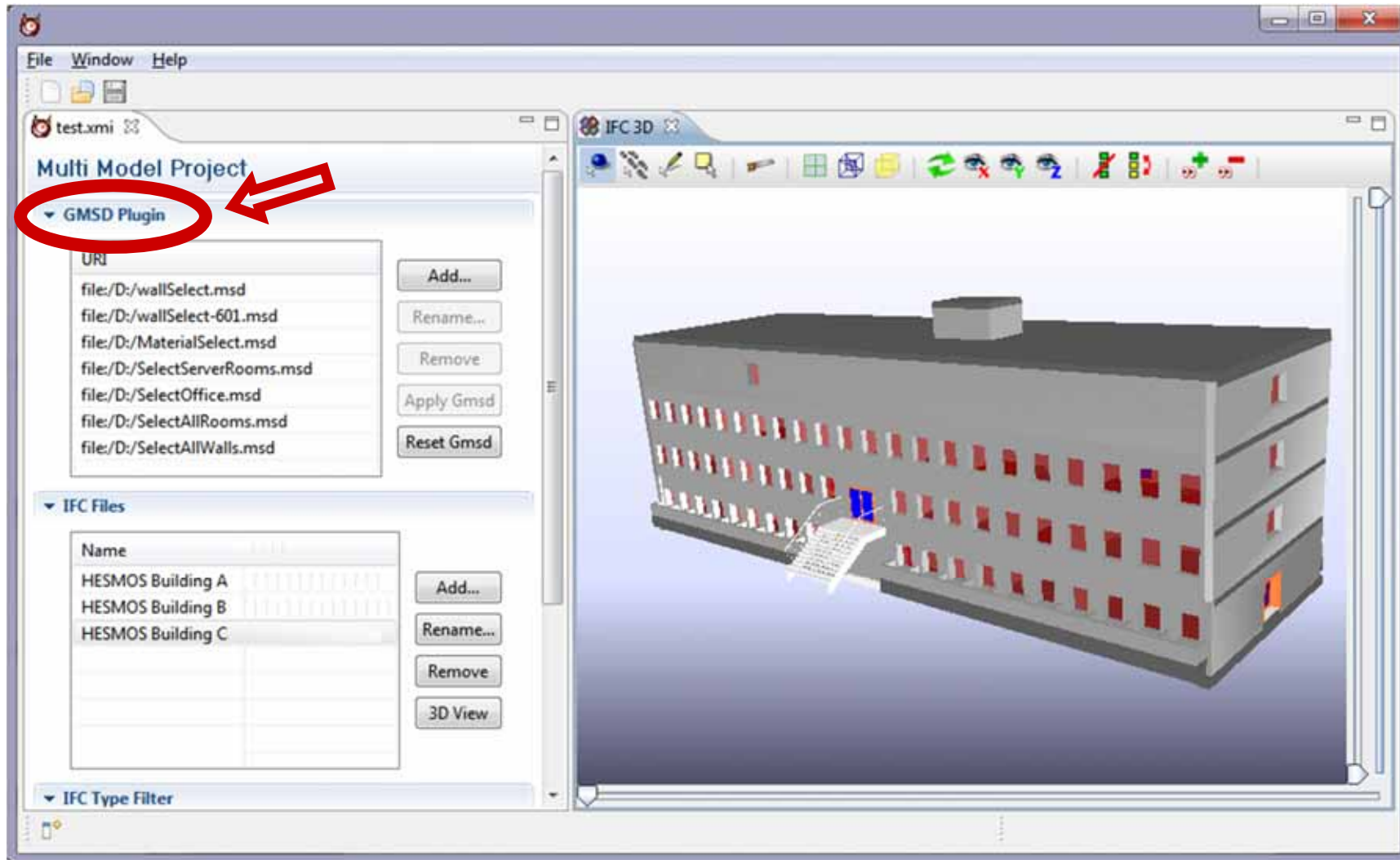




# Technological Approach

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## Level 1: BIM View Definition





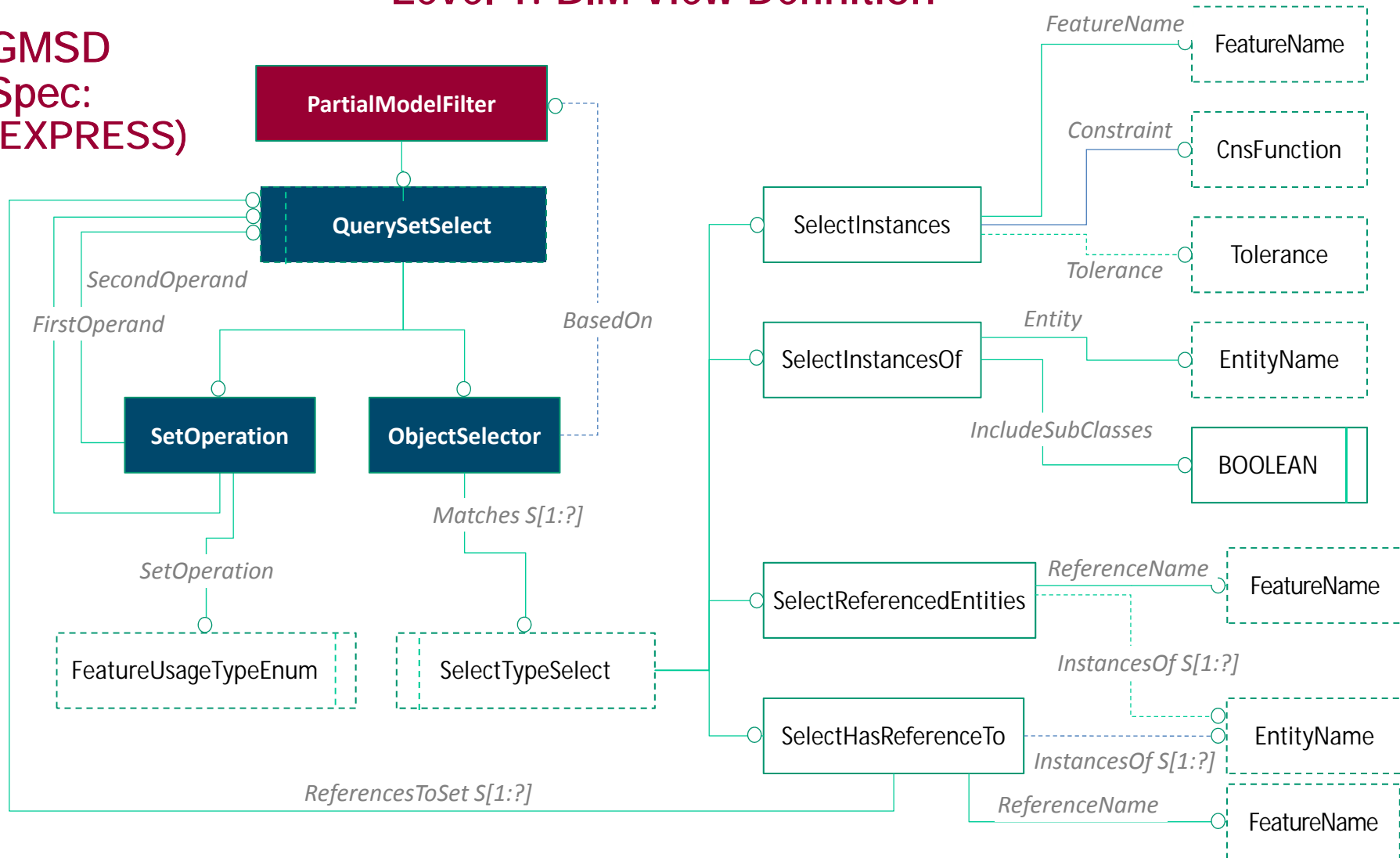


# Technological Approach

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## Level 1: BIM View Definition

GMSD  
Spec:  
(EXPRESS)





# Technological Approach

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## Level 1: BIM View Definition

GMSD  
Use:  
ViewEdit

The screenshot displays the ViewEdit software interface for defining an IFC2x4 RC1 entity. The interface is divided into several panels:

- Left Panel (Entity List):** Shows a tree view of IFC entities. The **IfcElement** entity is selected, and its properties are listed, including **Supertype of**, **Subtype of**, **Tag**, **FillsVoids [0:1]**, **ConnectedTo [0:?]**, **IsInterferedByElements [0:?]**, **InterferesElements [0:?]**, **HasProjections [0:?]**, **ReferencedInStructures [0:?]**, **HasOpenings [0:?]**, **IsConnectionRealization [0:?]**, **ProvidesBoundaries [0:?]**, **SET**, **IfcRelSpaceBoundary**, **ConnectedFrom [0:?]**, and **ContainedInStructure [0:1]**. A red circle '1' is placed next to the **IfcElement** entity.
- Center Panel (Entity Graph):** Shows a hierarchical tree view of the **EnergyManagementView** entity. The **IfcElement** entity is selected, and its properties are listed, including **HasOpenings**, **ContainedInStructure**, **ProvidesBoundaries**, **Subview - Space Boundaries**, **IfcRelSpaceBoundary**, **RelatingSpace**, **Subview - Space Boundaries**, **PhysicalOrVirtualBoundary**, **RelatedBuildingElement**, **EnergyManagementView**, **InternalOrExternalBoundary**, **IfcObject**, **IfcObjectDefinition**, **IfcOpeningElement**, **IfcOpeningStandardCase**, **IfcProduct**, **ObjectPlacement**, **Subview - ObjectPlacement**, **Representation**, **Subview - Representation**, and **IfcProductRepresentation**. A red circle '2' is placed next to the **IfcElement** entity.
- Right Panel (Entity Definition):** Shows the definition of the **Ifc2x4\_RC1.IfElement** entity. The **Name** is **Ifc2x4\_RC1.IfElement**. The **Inherit definition from superclass** checkbox is checked. The **Generalize to superclass** checkbox is unchecked. The **Predefined feature usage** is **UseEntityAndRemoveAllFeatures**. The **Annotation** field is empty. A red circle '3' is placed next to the **Name** field.

The bottom of the interface shows a **Panel** and **Hits** section:

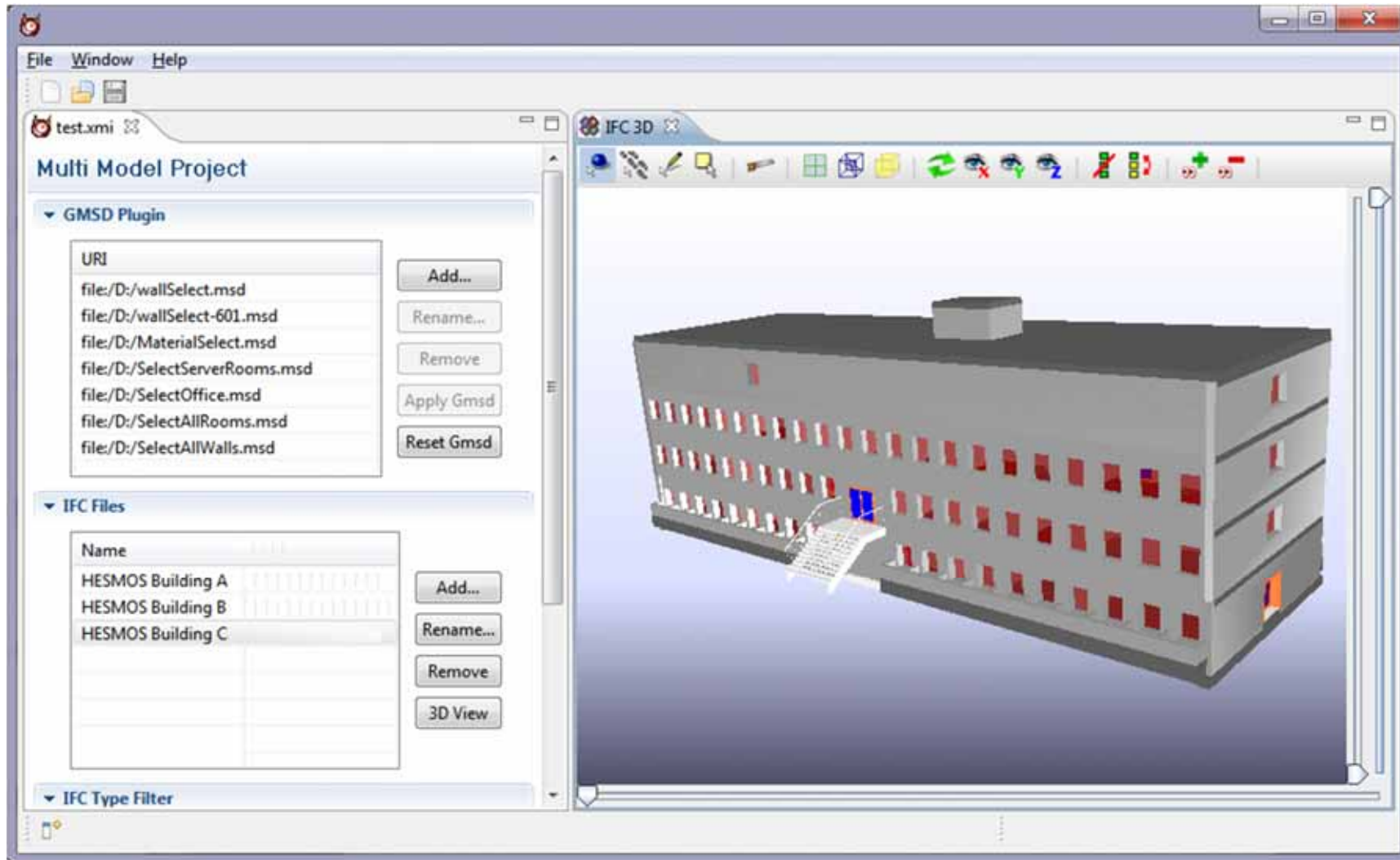
Panel	Hits
Schema	Schemas - IFC2x4_RC1 - Entity list - IfcElement
Schema	Schemas - IFC2x4_RC1 - Entity graph - IfcRoot - IfcObjectDefinition - IfcObject - IfcProduct - IfcElement



# Technological Approach

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## Level 1: BIM View Definition



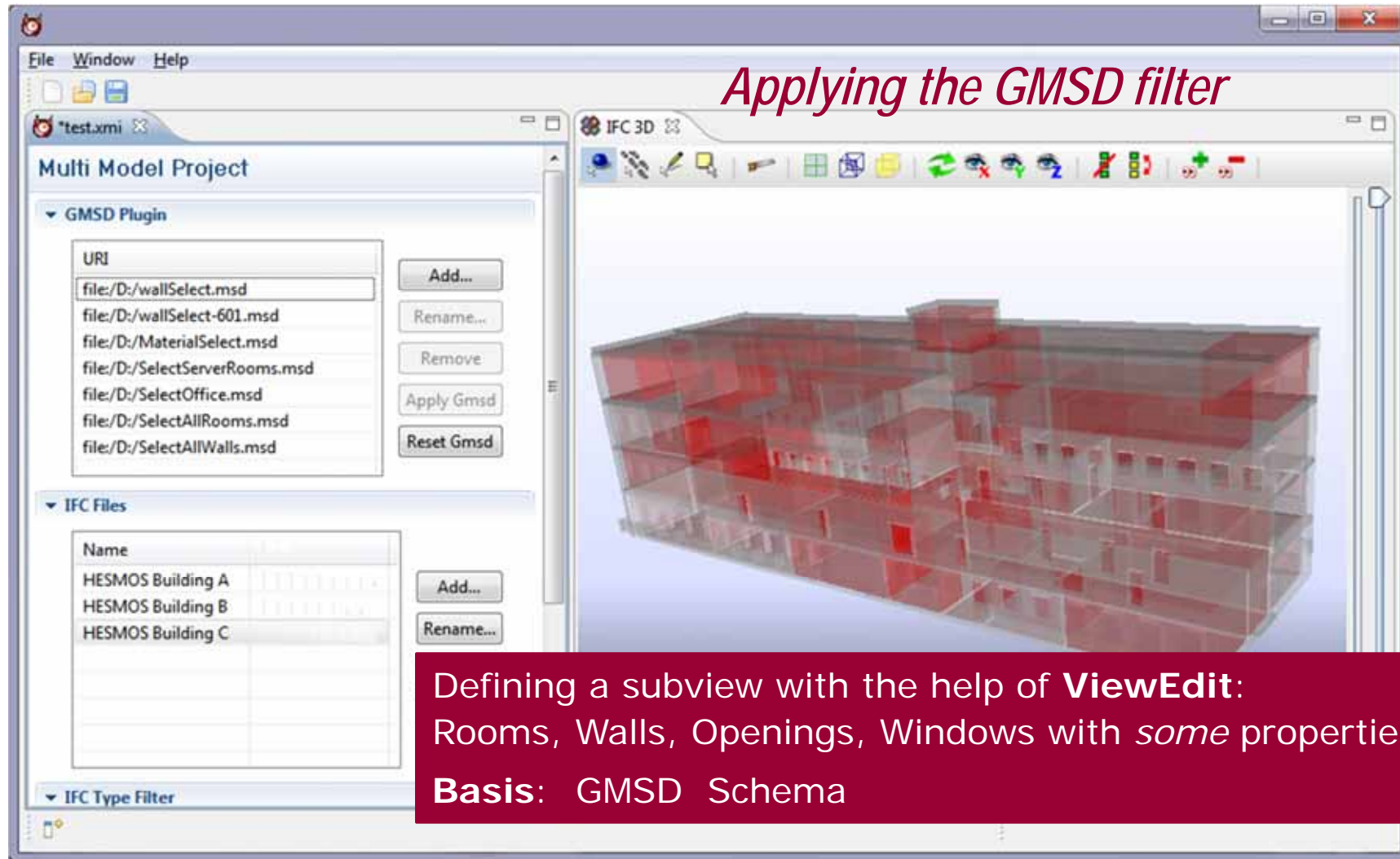




# Technological Approach

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## Level 1: BIM View Definition





# Technological Approach

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## Level 2: Adding Class Level Constraints

*Room use = 'Server room'*

Additional view adaptation based on attribute type/value constraints

**Basis:** GMSD Selection Capabilities integrated in the target application or defined externally in advance  
**Uses the already processed View Definition.**

Name	URI
HESMOS Building A	file/D:/IFC-Beis...
HESMOS Building B	file/D:/HWK_EG...
HESMOS Building C	file/D:/Nutzer/...





# Technological Approach

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## Level 3: Object Level Multi-Model Filtering

Criteria: T > 40 AND H > 45

Room	T [°C]	H [%]
100	43,0	48,5
103	43,2	52,3
106	40,1	46,9

Global ID

- a63e8a4b241f46d4b42d94
- 2caf13ddb074bf7bd2db9
- 160f10be735b4acebe1acc

**BIM – Sensor Model – Link**

**Load add-on domain models** and optionally filter their data  
**Create a Link Model** (BIM - Domain model(s))  
**Define additional (ad-hoc) filters** to query specific multi-model properties or prepare input for a specialised application  
**Basis:** Link Model, Engineering Query Language



# Conclusions

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- Multi-model view definition is an important prerequisite for the efficient implementation and use of BIM in practice
- The suggested methodology and tools help to better structure and further enhance the model view definition process
- GMSD and ViewEdit can support and accelerate modelers' work
- OpenIfcTools and our new Multi Model Framework can help developers to implement, validate and put to market specialized BIM-based software faster
- Further refinements needed in several detail issues regarding
  - Performance
  - Functionality
  - Flexibility
  - User interface
  - ...

**Thank You !**