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EVALUATION OF ORGANISATIONAL CONTEXT AND REQUIREMENTS FOR LEVERAGING BUILDING INFORMATION MODELS TO SUPPORT HANDOVER AND OPERATIONS & MAINTENANCE

Presented by
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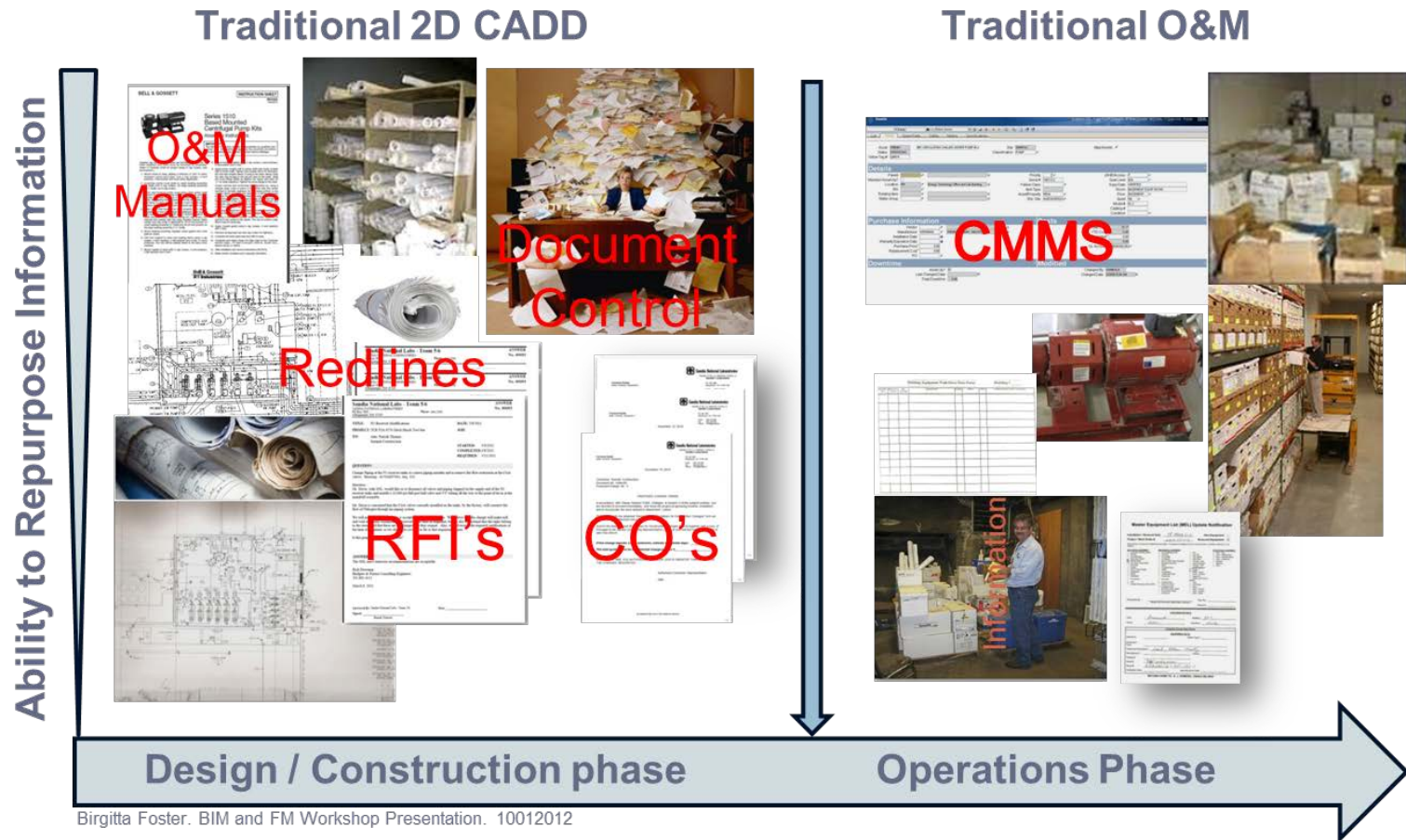
5th International/11th Construction Specialty Conference
Vancouver, British Columbia, June 8-10, 2015

Outline

- Introduction and Motivation
- Objective
- Methodology
- Case study
- Conclusion



Current Practice - Handover and O&M



Current problems related to handover

Poor information fidelity

- 30% (estimated) of the content of document-based O&M manuals contains some type of errors. (East and Nisbet, 2010)
- Submitted documents are less than satisfactory
(East and Brodt, 2007)

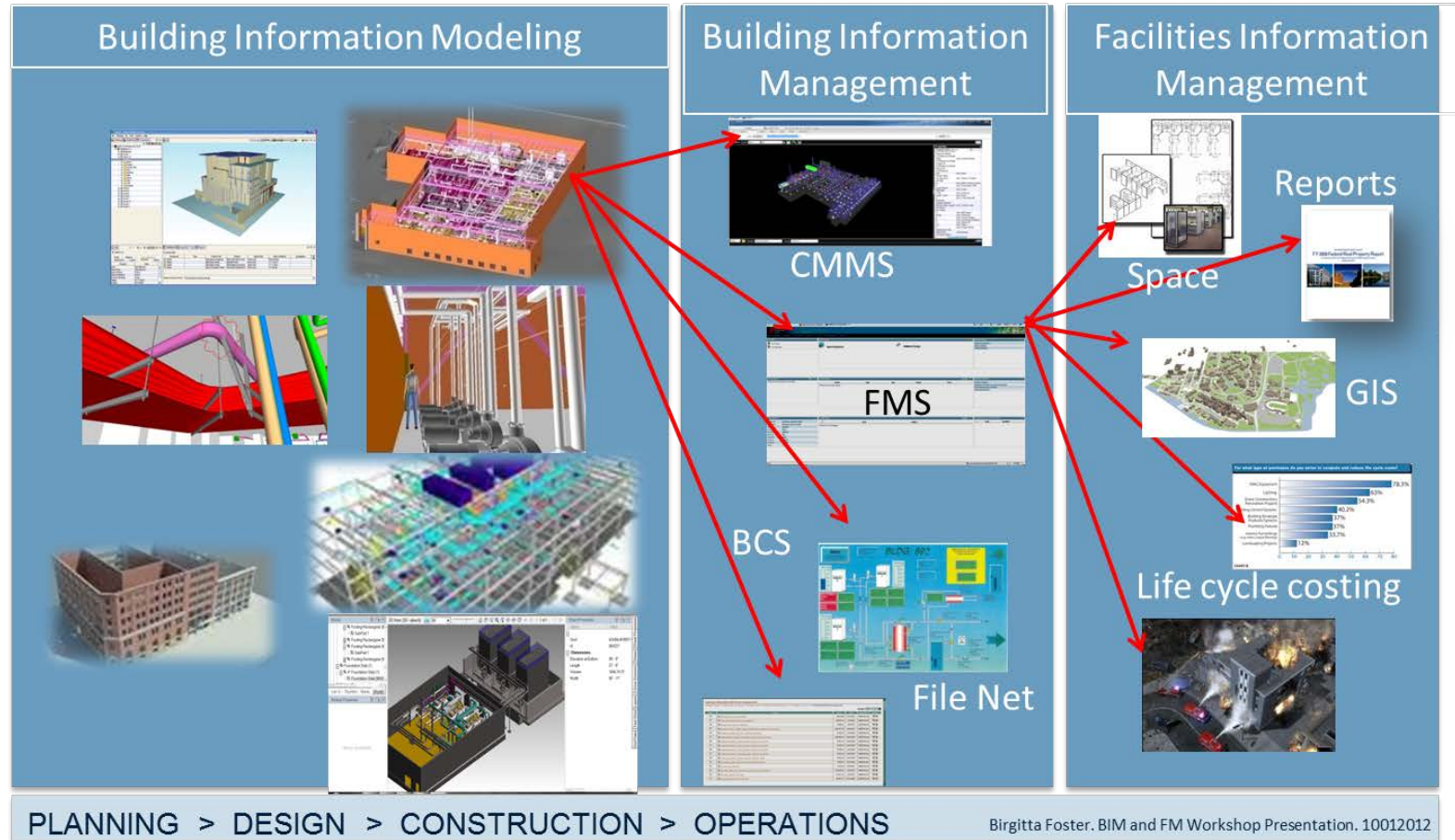
Poor interoperability

- "...the cost of inadequate interoperability in the U.S. capital facilities industry to be \$15.8 billion per year."
(Gallaher et al. 2004)

Poor building performance

- %85 of complaints on comfort & high energy consumption are due to handover and maintenance problems
[Netherlands Organisation for Applied Scientific Research (TNO) Survey]

Promises of BIM

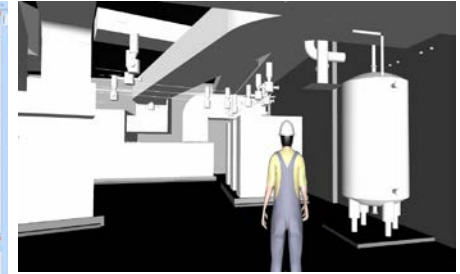
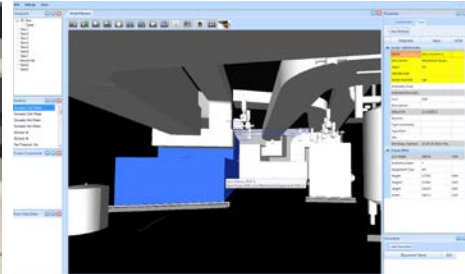
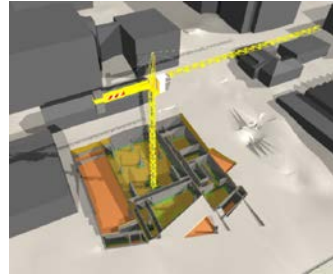
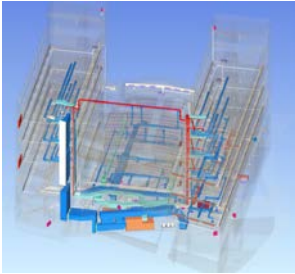
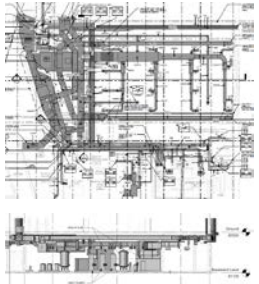


Birgitta Foster. BIM and FM Workshop Presentation, 10012012

Challenges of BIM for FM

AEC industry has been implementing BIM

What does it take for owner organisations to implement BIM for FM?



DESIGN

CONSTRUCTION

OPERATIONS

Model content?
Processes?

Model structure?
REQUIREMENTS

Information?
Who, what, when?

MODEL

Organisational structures?
Processes?

REQUIREMENTS
Culture?

Information systems infrastructure?
Processes?

ORGANISATION

Objective

Benchmark and evaluate the current state, and the alignment between;



Current design and construction **model context**



Owner/user **requirements**



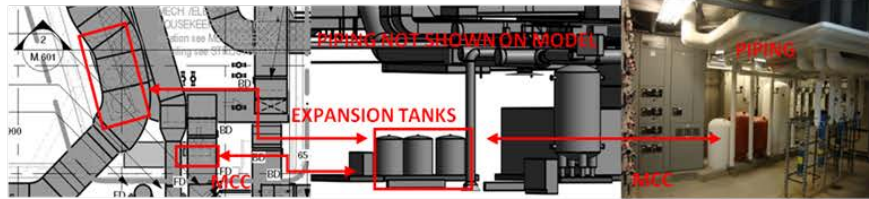
Organisational context

- organisational breakdown
- processes
- information systems infrastructures

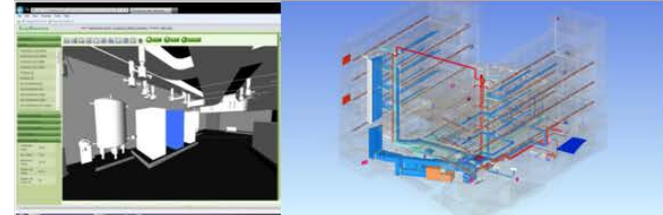
Methodology

MODEL

Model & Handover Document Comparison



Model Content & Structure Analysis



REQUIREMENTS



Interviews,
Walkthrough, Shadowing

CIRS



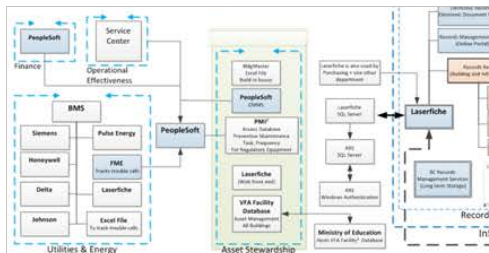
Maintainability
Analysis

Owner/User
Requirements
Analysis

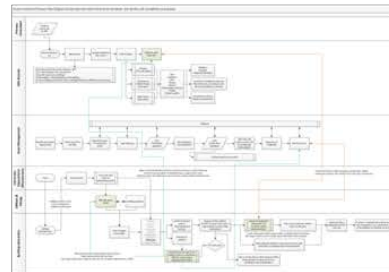


ORGANISATION

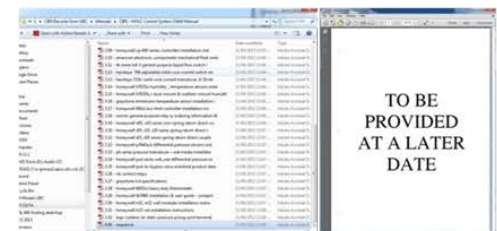
Analysis of Organisational & Technology Infrastructure



Analysis and Mapping of FM Processes



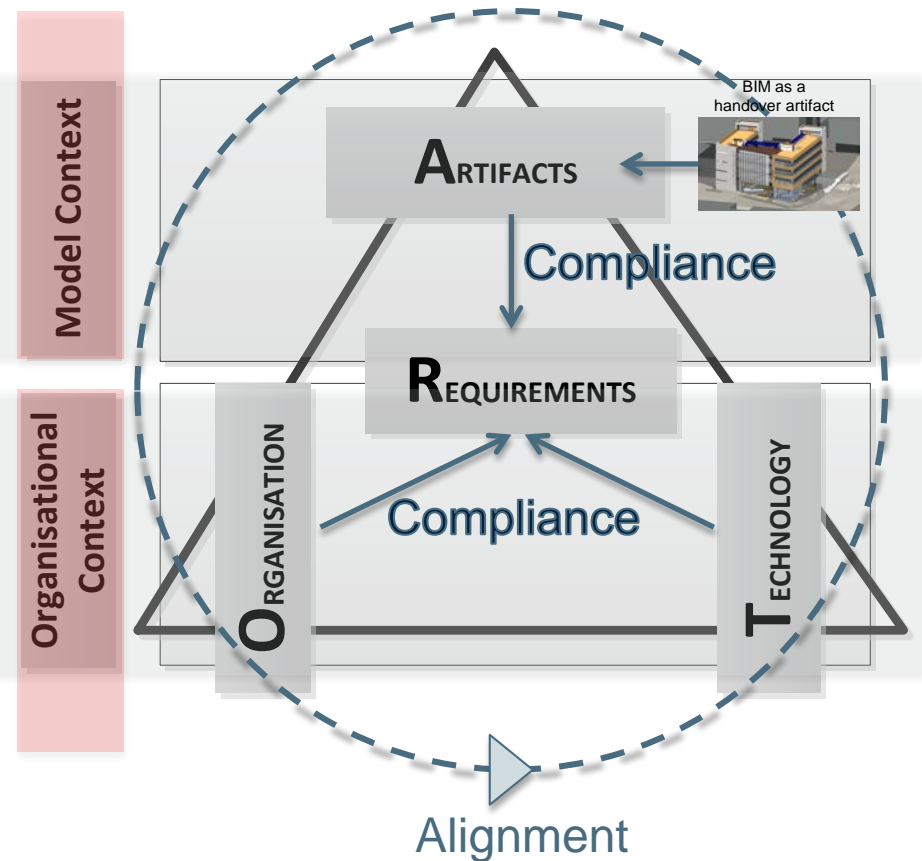
Handover Document Analysis



Methodology - Transition to BIM for FM

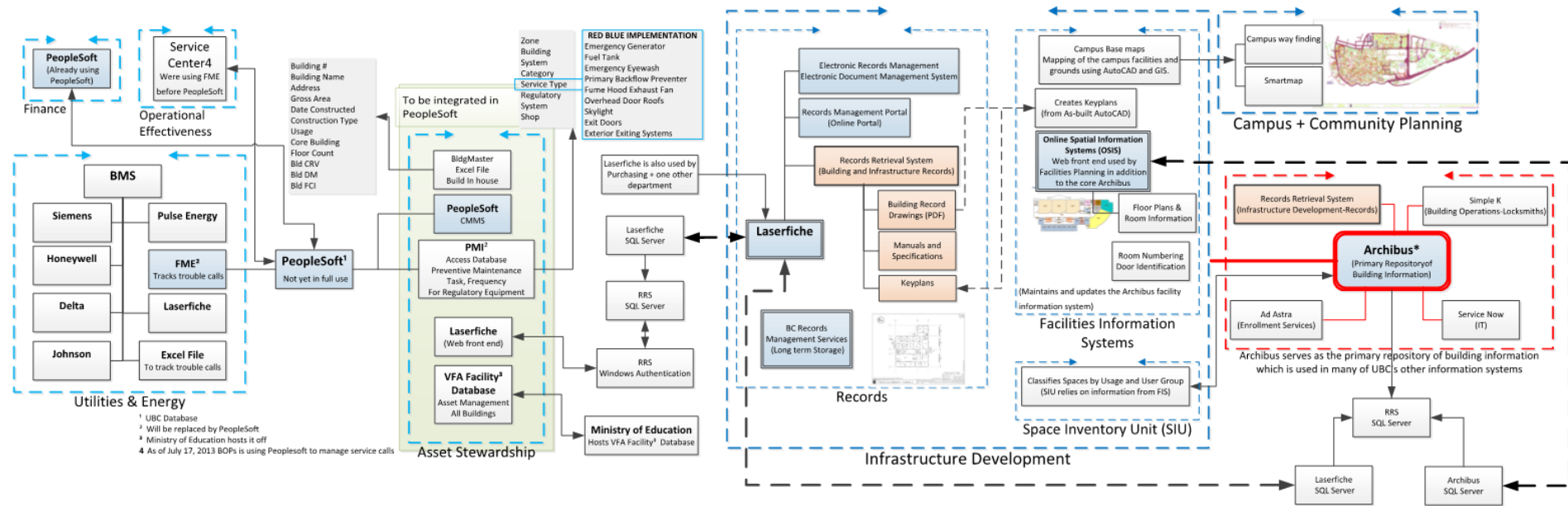
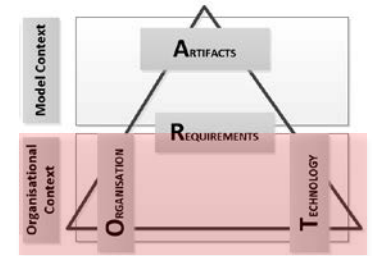
Traditional design and construction models need to be significantly reworked to make them useful for O&M tasks

We need to understand how a model-based process aligns with a given organizational structure and processes



Organisational Context

Challenge: Alignment and compliance problems due to the complex structure of organisations and technologies used to manage and support FM



Building maintainability problems Maintenance information flow problems Unintegrated asset databases Poor access to information Technologies not supported by processes Unintegrated technologies Information not reusable BMS information representation issues

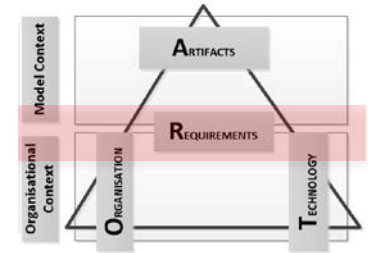


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Requirements

Challenge: Required compliance to O&M personnel's different sets of information in different levels of detail, format and visualisations.

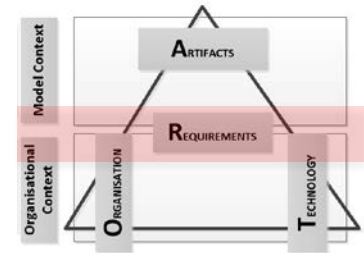




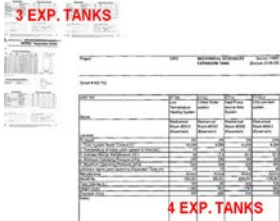
	System Attributes	Component Attributes	Maintenance Information	Records Information
Maintenance Personnel	System visualization System performance (commissioning information)	Component performance, Replacement part, Vendor information, Serial number, Location, Cost to replace/ maintain etc.	Electrical panel location, Shut off valve location, Start-up/ shut down information (sequence of operation), Maintenance history	Component performance (O&M), warranty
BMS	Accurate system visualization System performance (commissioning information)	Location, Performance,		Commissioning, and records information
Asset Mngmnt	System (availability)	Equipment lists, System it belongs to Cost information (to replace and/or to maintain)	Maintenance history	

What information is required?
At what level?
How much information is enough?

Requirements

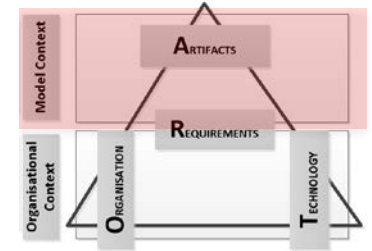
Challenge: Handed over buildings and handover sets have compliance issues with the owner requirements



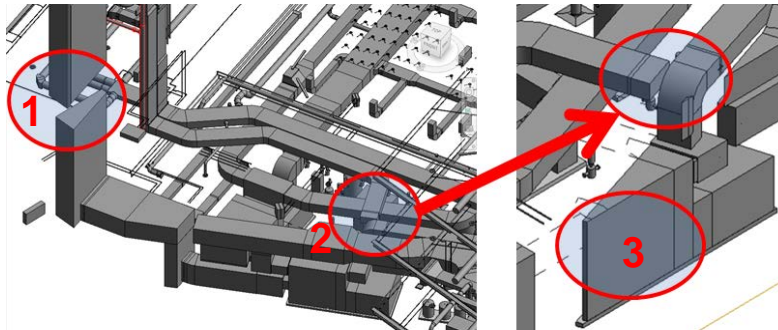
Owner/User Requirements	Delivered to Owner	Description
<p><i>Confirm that all plumbing equipment requiring frequent maintenance is readily accessible.</i></p> <p><i>Do not locate at ceiling height, in walls, requiring scaffolds, ladders, removal of other equipment.</i></p>		<p>Pumps are installed on the ceiling and buried under a maze of pipes making it difficult to access for maintenance.</p> <p>Crews will need to remove other components, use equipment (like ladders and lifts) to remove the pumps that are installed at the ceiling height.</p>
<p>Timely delivery of the handover information is required.</p>		<p>O&M personnel need the building information to perform O&M tasks. However required information may not be available at the time of handover.</p>
<p>Quality and reusability of the handover deliverables is depended on the project participants.</p>		<p>Information inconsistencies within the handed over information set.</p> <p>Much of the handover information is not searchable, scanned images that limit usability.</p>

Model Context

Challenge: Alignment and compliance problems related with the model content and structure.



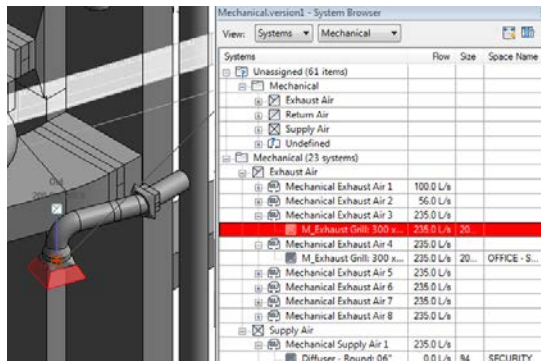
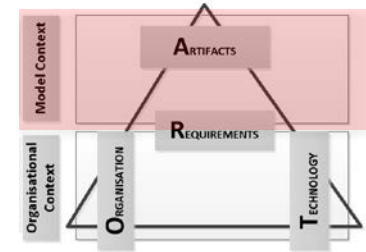
Analysis of the model content by using a life-cycle information management tool indicated that most of the information required by the owner for the handover was not available in the model.



Modeling errors (like missing system components);
 (1) model component representing the air intake is not represented as one complete piece,
 (2) duct not attached to the AHU.
 (3) LOD is not at a level to represent required AHU components tracked by the owner.

Model Context

Challenge: Alignment and compliance problems related with the model content and structure.



Single components (e.g. a single exhaust grill) are defined as systems in the model.

Space information is not assigned to all mechanical equipment.

System and equipment nomenclature do not indicate anything significant to the model reviewer.

Information by Owner

Attribute	Attribute Name	Subtype	Type
	AHU Cooling Coil Type	AHU	
	AHU Heating Coil Type	AHU	
	AHU Humidifier Type	AHU	
	AHU PreHeat Coil Type	AHU	
	AHU Heat Recov. Coil Type	AHU	
	AHU Return Fan Power Rating	AHU	
	AHU Roof Top Unit Type	AHU	
	AHU Supply Fan Flow	AHU	
	AHU Supply Fan Power Rating	AHU	

Model Content & Structure

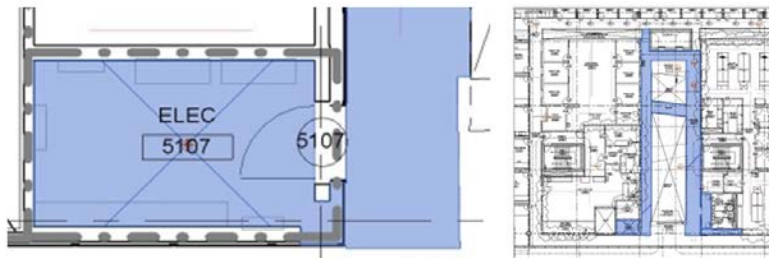
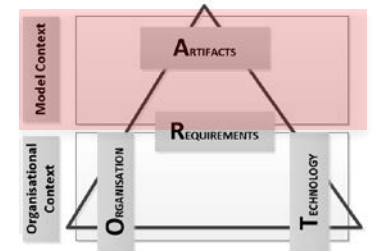


Information tracked by the owner on AHU components is not available in the model. AHU component does not represent any of the AHU components inside the unit.

Component naming used in the model is not aligned with the nomenclature used in owner's asset database.

Model Context

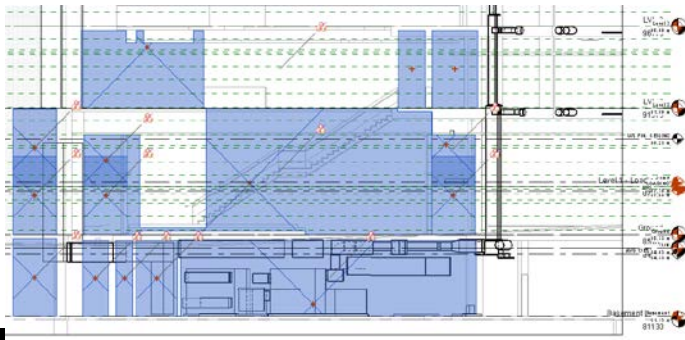
Challenge: Alignment and compliance problems related with the model content and structure.



Modeling errors lead to miscomputation of room areas, and room boundaries. This leads to errors when assigning equipment to spaces.



Modeling errors like duplications of created spaces or overlapping spaces impact the quality and usability of the model output.



Problems like overlapping space defining model components lead to issues when assigning equipment to spaces. This gets more complicated when defining spaces that extend multiple floors or mezzanines.

Conclusion

Organisational Context

Organizations need to

- **reshape the way they manage their facility information** both before and after the building handover.
- **reshape the way they function** so that they are better aligned with a model-based workflow



Conclusion

Model Context

Extensive processing required to configure the design BIM to satisfy O&M requirements.

- **Geometric and non-geometric content** needs to be added to the model
- Models need to be **re-structured** to enable transfer of model information in an accurate and reusable way.

Conclusion

Requirements

- Requirements need to be spelled out clearly
- Owners need to be supported with the means and methods that enable evaluation of handover set's compliance according to the requirements

REFERENCES

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- East, W. E., & Brodt, W. (2007). BIM for construction handover. *Journal of Building Information Modeling*, 28-35.
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