Outline

• Introduction and Motivation
• Objective
• Methodology
• Case study
• Conclusion
Current Practice - Handover and O&M

Traditional 2D CADD

O&M Manuals

Redlines

RFI’s

CO’s

Traditional O&M

CMMS

Ability to Repurpose Information

Design / Construction phase

Operations Phase

Birgitta Foster. BIM and FM Workshop Presentation: 10012012
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

Building Information Modeling
Building Information Management
Facilities Information Management

PLANNING > DESIGN > CONSTRUCTION > OPERATIONS

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?

**REQUIREMENTS**

**DESIGN**

- Model content?
- Model structure?
- Processes?

**CONSTRUCTION**

- Information?
- Who, what, when?

**OPERATIONS**

- Organisational structures?
- Processes?
- Culture?

**MODEL**

- Information systems infrastructure?

**ORGANISATION**

- Processes?
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 & Handover Document Comparison
- Model Content & Structure Analysis
- Interviews, Walkthrough, Shadowing
- CIRS
- Maintainability Analysis
- Owner/User Requirements Analysis
- Analysis of Organisational & Technology Infrastructure
- Analysis and Mapping of FM Processes
- Handover Document Analysis
- TO BE PROVIDED AT A LATER DATE
We need to understand how a model-based process aligns with a given organizational structure and processes.

Traditional design and construction models need to be significantly reworked to make them useful for O&M tasks.
Challenge: Alignment and compliance problems due to the complex structure of organisations and technologies used to manage and support FM

Organisational Context

- Unintegrated asset databases
- Poor access to information
- Technologies not supported by processes
- Unintegrated technologies
- Information not reusable
- BMS information representation issues
### Challenge:
Required compliance to O&M personnel's different sets of information in different levels of detail, format and visualisations.

<table>
<thead>
<tr>
<th>Maintenance Personnel</th>
<th>System Attributes</th>
<th>Component Attributes</th>
<th>Maintenance Information</th>
<th>Records Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>System visualization</td>
<td>Component</td>
<td>Electrical panel</td>
<td>Component performance</td>
<td></td>
</tr>
<tr>
<td>System performance</td>
<td>performance,</td>
<td>location,</td>
<td>(O&amp;M), warranty</td>
<td></td>
</tr>
<tr>
<td>(commissioning</td>
<td>Replacement part,</td>
<td>Shut off valve</td>
<td></td>
<td></td>
</tr>
<tr>
<td>information)</td>
<td>Vendor</td>
<td>location,</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>information,</td>
<td>Start-up/ shut down</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Serial number,</td>
<td>information</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Location,</td>
<td>(sequence of</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cost to replace/</td>
<td>operation),</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>maintain etc.</td>
<td>Maintenance history</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| BMS                    | Accurate system   | Location,           | Commissioning, and     |
|                        | visualization     | Performance,        | records information    |
| System performance     |                   |                     |                         |
| (commissioning         |                   |                     |                         |
| information)           |                   |                     |                         |

| Asset Mgmt             | System            | Equipment lists,    | Maintenance history    |
|                        | (availability)    | System it belongs  |                         |
|                        |                   | to                   |                         |
|                        |                   | Cost information    |                         |
|                        |                   | (to replace and/or  |                         |
|                        |                   | to maintain)        |                         |

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

**Challenge:** Handover buildings and handover sets have compliance issues with the owner requirements

<table>
<thead>
<tr>
<th>Owner/User Requirements</th>
<th>Delivered to Owner</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Confirm that all plumbing equipment requiring frequent maintenance is readily accessible. Do not locate at ceiling height, in walls, requiring scaffolds, ladders, removal of other equipment.</td>
<td><img src="image1.png" alt="Image" /></td>
<td>Pumps are installed on the ceiling and buried under a maze of pipes making it difficult to access for maintenance. Crews will need to remove other components, use equipment (like ladders and lifts) to remove the pumps that are installed at the ceiling height.</td>
</tr>
<tr>
<td>Timely delivery of the handover information is required.</td>
<td><img src="image2.png" alt="Image" /></td>
<td>O&amp;M personnel need the building information to perform O&amp;M tasks. However, required information may not be available at the time of handover.</td>
</tr>
<tr>
<td>Quality and reusability of the handover deliverables is depended on the project participants.</td>
<td><img src="image3.png" alt="Image" /></td>
<td>Information inconsistencies within the handed over information set. Much of the handover information is not searchable, scanned images that limit usability.</td>
</tr>
</tbody>
</table>
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.
**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 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.
**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


Thank you…