construction operations building information exchange (COBIE)

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IFC – COBIE Mappings

• (1) IDM for contracted data exchanges
  – Exchange requirements
  – Function Parts
  – Business rules
• (2) MVD for FM View
  – Plus local rules
• (3) Partial schema
  – Part of ifc2x3
• (4) Working document
  – Spreadsheet with options and alternatives
• (5) Published tolerant transformations
  – IFC->COBIE
  – COBIE -> IFC
(1) Information Delivery Contract

- Users checklist
(2) MVD

• Implementers checklist
(3) Schema Subset

- i.e. Service Life
(4) Spreadsheet

- i.e. 06-Register ⇔ Ifc Type Product
(5) Transform

```
<xsl:call-template name="putString">
  <xsl:with-param name="mode" select="$mode"/>
  <xsl:with-param name="shade" select="Specifiable"/>
  <xsl:with-param name="text">
    <xsl:choose>
      <xsl:when test="$mode='Header'">FacilityDescription</xsl:when>
      <xsl:otherwise>
        <xsl:value-of select="ifc:Description"/>
      </xsl:otherwise>
    </xsl:choose>
  </xsl:with-param>
  <xsl:with-param name="alternative">
    <xsl:value-of select="substring(name(.),4)"/>
    <xsl:if test="ifc:LongName">
      <xsl:text>/</xsl:text>
    </xsl:if>
  </xsl:with-param>
<xsl:call-template/>
```
COBIE ↔ IFC tool

http://www.buildersnet.org/IFC-BIM

- translate between COBIE spreadsheet and IFC data.
- report and compare asset representations.
ifcCOBIE - transforming

- C: ifcCOBIE house.ifc
- ifcCOBIE (c) AEC3 2008.07.10 email:nn@aec3.com
- Source 1: house.ifc
- Schema: IFC2X3_FINAL.exp (external resource)
- Map: ifcXML_cobie.xsl (external resource)
- Mapping: ifcXML_cobie.xsl (msxml)
- Writing: house.xml COBIE (Excel XML Spreadsheet 2003) spreadsheet (msxml)
- ifcCOBIE finished.
ifcCOBIE - reporting

- C: \ifcCOBIE  -l model7.ifc
- (c) AEC3 2008.07.10 email:nn@aec3.com

- Source 1: model7.ifc
- Schema : IFC2X3.exp (external resource)
- Object : COBIE_Master, Project (2qJ78_GWH5jvuSGGMg$GPY)
  - Value : ..LongName Cobie Demonstration
  - Related : ..IsDecomposedBy RelatedObjects RelAggregates
- Object : ....Madison Alabama, -, Site (3APCt_4CX3KP3IfyeDhIwc)
  - Value : ......LongName Madison Alabama
  - Related : ......IsDecomposedBy RelatedObjects RelAggregates
- Object : ........BIM Sample US, -, Building (3cbtxXMir4xRdN00I5ZGkr)
  - Value : ..........LongName BIM Sample US
  - Related : ..........IsDecomposedBy RelatedObjects RelAggregates
- Object : ..........First Flr, First Floor, BuildingStorey (2c10clo09AGB3qtucGbh4d)
  - Value : ..........LongName First Flr
  - Related : ..........IsDecomposedBy RelatedObjects RelAggregates
- Object : ................1-107, Reception, Space (1qMCLLDnX8P9RUv9mSPzSh)
  - Value : ..................ObjectType Reception
  - Value : ..................LongName Reception
  ...

5-Aug-08 Contracted Information Exchange Demo
ifcCOBIE - differences

- C:> ifcCOBIE -l model7.ifc model7a.ifc
- (c) AEC3 2008.07.10 email:nn@aec3.com

- Compare : model7.ifc with model7a.ifc
- Schema : IFC2X3.exp (external resource)
- Reading < model7.ifc (engine)
- Reading > model7a.ifc (engine)
- ...
  - Matched = ....................2-205, Office, Space (3G$h2FQj9JBoIgjvFN2mA)
  - Related : ....................IsDefinedBy RelatingPropertyDefinition
  - Matched = ....................ArchSpace, -, PropertySet (2PwiWZ1z2ohMRPLVSkVUS)
  - Related : ....................HasProperties
  - Matched = .......................Label, -, Office, PropertySingleValue
  - Matched = .........................Number, -, 2-205, PropertySingleValue
  - Matched = .........................Label 2, -, , PropertySingleValue
  - Matched = .........................Ceiling Height, -, 2.5908, PropertySingleValue
  - Matched = ........................Program Area, -, 13.93546, PropertySingleValue
  - Matched = ........................Actual Area, -, 14.67694, PropertySingleValue
  - Changed < .........................NominalValue 11.50146
  - Changed > ........................NominalValue 14.67694
compliance

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Example challenge

• Rename space

• Refine the type information
Sample Check Result

Processing '06-Register' Worksheet Check

Data file display suppressed per user request for non-verbose output.
(45 XML records found (include column header), 44 possible COBIE records were analyzed as noted below.)

<table>
<thead>
<tr>
<th>Column</th>
<th>Rule Description</th>
<th>Pass/Fail</th>
<th>Errors Found</th>
<th>Offending Records</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>RegisterID</td>
<td>record ID's must be numeric</td>
<td>Pass</td>
<td>-</td>
</tr>
<tr>
<td>A</td>
<td>RegisterID</td>
<td>record ID's must be increasing</td>
<td>Pass</td>
<td>-</td>
</tr>
<tr>
<td>A</td>
<td>RegisterID</td>
<td>record ID's must be unique</td>
<td>Pass</td>
<td>-</td>
</tr>
<tr>
<td>B</td>
<td>ProductType</td>
<td>All register records shall have OmniClass product codes</td>
<td>Pass</td>
<td>-</td>
</tr>
<tr>
<td>C</td>
<td>RegisterType</td>
<td>All register records must indicate data type</td>
<td>Pass</td>
<td>-</td>
</tr>
<tr>
<td>D</td>
<td>AssetType</td>
<td>All register items must indicate asset type</td>
<td>Pass</td>
<td>-</td>
</tr>
<tr>
<td>E</td>
<td>RegisterApprovalBy</td>
<td>All register items must indicate approval level</td>
<td>Pass</td>
<td>-</td>
</tr>
<tr>
<td>F</td>
<td>SystemIDList</td>
<td>Product Data submittals must indicate related system(s)</td>
<td>Pass</td>
<td>-</td>
</tr>
<tr>
<td>H</td>
<td>ExternalSystemName</td>
<td>If created by software export, system name must be listed</td>
<td>Pass</td>
<td>-</td>
</tr>
<tr>
<td>I</td>
<td>ExternalNameID</td>
<td>If created by software export, external ID name must be listed</td>
<td>Pass</td>
<td>-</td>
</tr>
<tr>
<td>J</td>
<td>RegisterName</td>
<td>Submittal item name must be provided</td>
<td>Pass</td>
<td>-</td>
</tr>
<tr>
<td>K</td>
<td>RegisterReference</td>
<td>Submittal specification reference must be provided</td>
<td>Pass</td>
<td>-</td>
</tr>
<tr>
<td>L</td>
<td>ReplacementCost</td>
<td>A numeric value may be provided for replacement cost</td>
<td>Check 11</td>
<td>1, 2, 3, 4, 5, 6, 8, 22, 23, 24, 44</td>
</tr>
<tr>
<td>M</td>
<td>ReplacementCostUnits</td>
<td>A value must be provided for the replacement cost units</td>
<td>Pass</td>
<td>-</td>
</tr>
<tr>
<td>N</td>
<td>ExpectedLife</td>
<td>A numeric value may be provided for expected life</td>
<td>Check 11</td>
<td>1, 2, 3, 4, 5, 6, 8, 22, 23, 24, 44</td>
</tr>
<tr>
<td>O</td>
<td>ExpectedLifeUnits</td>
<td>A value must be provided for the replacement lift units</td>
<td>Pass</td>
<td>-</td>
</tr>
<tr>
<td>P</td>
<td>CreatedBy</td>
<td>records must identify who created the data</td>
<td>Pass</td>
<td>-</td>
</tr>
<tr>
<td>Q</td>
<td>CreatedDate</td>
<td>records must contain a data stamp</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>S</td>
<td>ReplacesID</td>
<td>updated records shall not identify themselves</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>S</td>
<td>ReplacesID</td>
<td>updated records shall reference an ID on the sheet</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Legend:  yellow = required  light grey = conditional  green = optional  red = change control
OPS summary

• Producing COBIE directly
  – 06-Register:
    • some missing replacement cost
    • some missing expected life.
Vectorworks

• Producing COBIE via IFC
  – 04-Space:
    • no area measures
    • no function
    • aggregate spaces used
  – 05-System:
    • none
  – 06-Register:
    • same number of register and component entries.
  – 07-Component:
    • 14 doors and windows have no space
    • Some doors are allocated to three spaces
Revit

• Producing COBIE directly
• Twice
  – Several issues ...
Revit direct to COBIE (1)

• 00-Structure
  – the instructions file did not contain information about the specific project, but reflected the "railway maintenance project" example
  – in general -. IFC GUID's or equivalent (i.e. system ID's) must be provided to allow checking across different spreadsheet submissions if the data is created from BIM software.

• 03-Floor.
  – InteriorGrossArea a non-numeric character was written to the field, possibly a "space" or equivalent in lieu of blank or "n/a". same for all in this worksheet.

• 04-Space.
  – SpaceReferenceID value must be blank unless showing nested spaces (error not shown in the checker since SelfReference check not included in checker at this time)
  – ExternalSystemName value does not identify "Revit Architecture 2009". The value for the system name does appear in the ExternalSystemName column in the Floor worksheet.

• 05-System.
  – repeated problem with SystemReferenceID and ExternalSystemName
  – inspection reveals that the list of systems seems unusual given the size of the building.
Revit direct to COBIE (2)

- 06-Register
  - register ID records not unique, two values of "19"
  - register type not spelled correctly "Test Report" provided vs. "Test Reports" which is allowable value.
  - while the number of Types (register) and Components (equipment) are not the same they are very close: there is not strong typing.
  - typically expect that register records, i.e. "types" will be part of a building service, hence missing system id's in the register are not correct. for example one would expect that Register ID 7 "Exhaust Air Grill" would be part of System ID "HVAC", note that when trying to identify which system the component belongs that this small building cannot really have all of these different mechanical systems.

- 07-Component
  - records 6, 7 reference spaces that do not exist. Rooftop and outdoor are specifically to be designated in spaces. This is consistent with the way that people think about areas outside the building envelop.
  - all named components must link back to 06-Register
## Revit: Direct to COBIE

### Processing '07-Component' Worksheet Check

Data file display suppressed per user request for non-verbose output.  
(214 XML records found (include column header); 24 possible COBIE records were analyzed as noted below.)

<table>
<thead>
<tr>
<th>Column</th>
<th>Rule Description</th>
<th>Pass/Fail</th>
<th>Errors Found</th>
<th>Offending Records</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>ComponentID: record ID's must be numeric</td>
<td>Pass</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>A</td>
<td>ComponentID: record ID's must be increasing</td>
<td>Pass</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>A</td>
<td>ComponentID: record ID's must be unique</td>
<td>Pass</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>B</td>
<td>SpaceID: Each component record must list it's SpaceID</td>
<td>FAIL</td>
<td>24</td>
<td>All rows include this fault.</td>
</tr>
<tr>
<td>C</td>
<td>RegisterID: Each component record must list it's RegisterID</td>
<td>FAIL</td>
<td>24</td>
<td>All rows include this fault.</td>
</tr>
<tr>
<td>C</td>
<td>RegisterID: Register data must be strongly typed. (RegisterCount &lt;&gt; ComponentCount)</td>
<td>Pass</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>D</td>
<td>ExternalSystemName: If created by software export, system name must be listed</td>
<td>Pass</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>E</td>
<td>ExternalNameID: If created by software export, external ID name must be listed</td>
<td>Warning</td>
<td>24</td>
<td>All rows include this fault.</td>
</tr>
<tr>
<td>E</td>
<td>ExternalNameID: External identifiers must be unique</td>
<td>-</td>
<td>-</td>
<td>test type 'ExternalNameUnique' not yet operational</td>
</tr>
<tr>
<td>F</td>
<td>ComponentName: Each component must be identified by name</td>
<td>Pass</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>F</td>
<td>ComponentName: Most components should have a unique number</td>
<td>-</td>
<td>-</td>
<td>test type 'UniqueComponent' not yet operational</td>
</tr>
<tr>
<td>G</td>
<td>ComponentDescription: Identifying product type in the description may be helpful</td>
<td>Pass</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>H</td>
<td>CreatedBy: records must identify who created the data</td>
<td>Pass</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>I</td>
<td>CreatedDate: records must contain a data stamp</td>
<td>-</td>
<td>-</td>
<td>test type 'Date' not yet operational</td>
</tr>
<tr>
<td>J</td>
<td>ReplacesID: updated records shall not identify themselves</td>
<td>-</td>
<td>-</td>
<td>test type 'SelfReference' not yet operational</td>
</tr>
<tr>
<td>J</td>
<td>ReplacesID: updated records shall reference an ID on the sheet</td>
<td>-</td>
<td>-</td>
<td>test type 'SheetReference' not yet operational</td>
</tr>
</tbody>
</table>

Legend:  
- = required  
- = conditional  
- = optional  
- = change control
Revit

• Producing COBie from IFC:
  – 02-Facility:
    • Not named
  – 04-Space
    • Super spaces present
  – 05-System:
    • None
  – 07-Component:
    • Many components without link to space
Bentley

• Producing COBIE from IFC:
  – 04-Space
    • ceiling heights invalid (ifcCOBIE)
  – 06-Component
    • Some doors, windows and ducts not associated to any space.
Metrics

• Summary

<table>
<thead>
<tr>
<th></th>
<th>Route</th>
<th>Scie Space areas</th>
<th>Cvie Proxies</th>
<th>COBie C/T ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>OPS</td>
<td>direct</td>
<td>net, gross</td>
<td>n/a</td>
<td>22.578</td>
</tr>
<tr>
<td>Bentley</td>
<td>via IFC</td>
<td>yes</td>
<td></td>
<td>4.071</td>
</tr>
<tr>
<td>Revit</td>
<td>direct</td>
<td>yes</td>
<td>n/a</td>
<td>0.532</td>
</tr>
<tr>
<td>Revit</td>
<td>via IFC</td>
<td>yes</td>
<td></td>
<td>1820</td>
</tr>
<tr>
<td>Vectorworks</td>
<td>via IFC</td>
<td>none</td>
<td></td>
<td>1.000</td>
</tr>
</tbody>
</table>
# Summary

<table>
<thead>
<tr>
<th></th>
<th>Route</th>
<th>Pass/fail</th>
<th>Quality /10</th>
</tr>
</thead>
<tbody>
<tr>
<td>OPS</td>
<td>direct</td>
<td>pass</td>
<td>9</td>
</tr>
<tr>
<td>Bentley</td>
<td>via IFC</td>
<td>pass</td>
<td>8</td>
</tr>
<tr>
<td>Autodesk</td>
<td>direct</td>
<td>fail</td>
<td>4</td>
</tr>
<tr>
<td>Autodesk</td>
<td>via IFC</td>
<td>pass</td>
<td>6</td>
</tr>
<tr>
<td>Vectorworks</td>
<td>via IFC</td>
<td>pass</td>
<td>7</td>
</tr>
</tbody>
</table>