Autodesk Consulting Add-on Utilities: COBie Toolkit and BIM Coordinator Tool

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Class Summary

We will demonstrate and discuss recent Autodesk Consulting add-on utilities, developed using mostly Revit and some AutoCAD Civil3D APIs:

- COBie (Construction Operations Building Information Exchange) Toolkit for Autodesk Revit software. COBie is XLS(X)-based standard for exchange of building systems information between designers, construction firms, and building owners that can now be populated directly from Revit's BIM.
- BIM Coordinator, available from Autodesk Labs, assists project team members with building and site grids in Revit and AutoCAD Civil 3D software to effectively organize the project data in shared or related coordinates. This utility is essential for spatial collaboration across disciplines.
- Time permitting, some other generic BIM tools for Revit

Learning Objectives

At the end of this class, you will be able to:

- Understand details of the COBie standard, including the U.S. version and the more recent U.K. version
- Export COBie Excel files directly from Revit in a flexible and configurable manner
- Use the BIM Coordinator tool to improve interoperability and spatial integration between AutoCAD Civil 3D and Revit
- Define specifications for custom (API-based) add-on tools to extend Autodesk Building Information Modeling (BIM) applications

Speakers and Audience Background

Miro

- extensive combined engineering and IT background, with a Dipl.Ing. degree in Civil and Structural Engineering and Ph.D. in Numerical Methods in Engineering
- 25+ years' experience in commercial engineering/AEC/BIM software development and customization.
- Fluent in English, Croatian (native), Italian, C#, VB.NET, C /C++, XML, STEP, OOA/OOD, old VBA/VB6, FORTRAN…
- at Autodesk for over 12 years, currently as Solution Architect with Autodesk Consulting (AC)
  - applying combined API, products, industry and process analyses knowledge to architecting and developing consulting solutions that extend the functionality of Autodesk BIM/AEC products and integrate them within various specific customer workflows and processes.
  - specializing in APIs for all Autodesk® AEC and BIM products, a topic on which he has conducted numerous training sessions, given many conference talks and designed/implemented many custom apps.

Rich

- responsible for advancing Building Information Modeling to building owners and promoting the role of BIM in the building lifecycle for Operations and Maintenance, Facilities Management, GIS and Building Control Applications.
- 30+ years industry experience in Facilities Management, Operations and Maintenance BIM, CAD, and GIS applications
- prior to Autodesk, worked for a software reseller as Vice President, managing all sales, support and consulting.
- at Autodesk for 15 years and has held various sales and technical positions, involved in
  - consulting, implementing and customization of these applications
  - integration with various systems and enterprise applications.

Audience - show of hands…

AcRvtClassification Tool

Revit's Classification Options - OmniClass

- Available in RFAs to select OmniClassNumber/OmniClasTitle params
- When loaded in RVT, these Type params become read-only
- Defined centrally, once only, in RFA and then available in RVTs.
- Areas for improvement:
  - Not available for system (non-RFA) families like Walls, Floors, Pipes, etc…
  - Not available for classifiable instance-based elements, most importantly Rooms, Spaces and Facility (ProjectInformation)
  - Nomenclature not officially customizable, see taxonomy file: *C:\ProgramData\Autodesk\RVT 2013\UserDataCache\OmniClassTaxonomy.txt*

Revit’s Classification Options - Uniformat

- Available via “Assembly Code” on Types
- Only within RVT, so can be changed in the model
- Not available for classifiable instance-based elements, most importantly Rooms, Spaces and Facility (ProjectInformation)
- Nomenclature not officially customizable, see definition file: *C:\ProgramData\Autodesk\RVT 2013\UserDataCache\UniformatClassifications.txt*

- **No concept for adding other classifications…**

Classification Tool for Revit

- To address some of these issues, AC tool designed and developed:
  - Easy and customizable classification definitions in XML files
    - Simple XML Elements and Attributes
    - Flexible “hints” to which Revit categories a classification applies
    - Flexible nested structure for classification items
  - Automatic creation of shared parameters to store the data
  - Includes Type and Instance Bindings
  - Single-point “Manager” UI dialog to deal with:
    - Importing/updating/removing of XML file into Revit
    - User-friendly and flexible User Interface to view/assign the values to Types/Instances

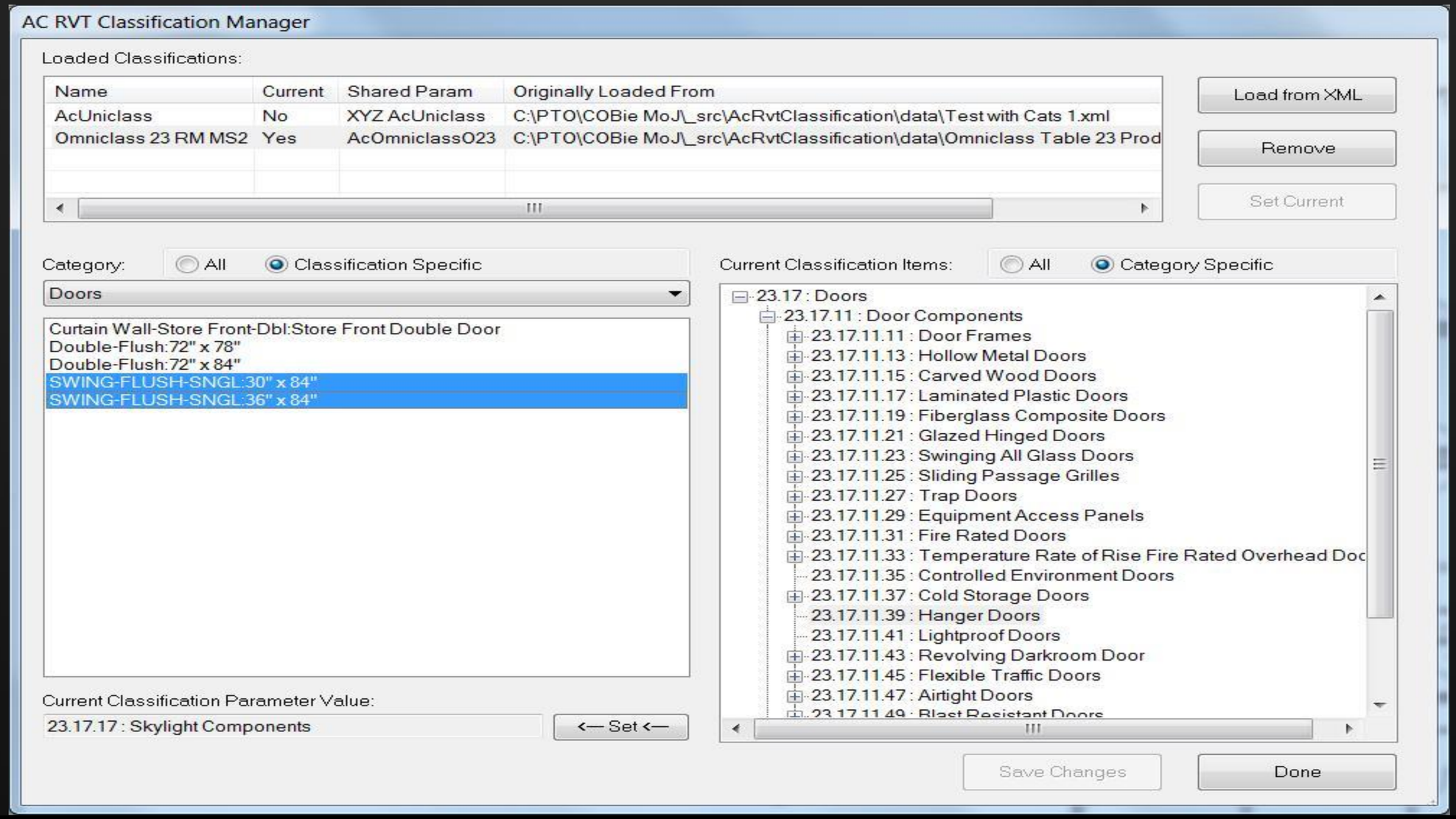
Classification Tool for Revit – XML file structure

```
<?xml version="1.0" encoding="utf-8"?>
<RvtClassification>

  <!-- Global Settings Values -->
  <!-- NOTES:
    Id: not used at the moment, but a unique GUID
    Name: Unique Id used for this clasification
    IdDescriptionSeparator: Id, this separator and Description are concatenated for display/param-value purpose
    SharedParamName: name of Revit's Shared Param to be used in conjunction with this classification
  -->
  <Id>123458F6-2E91-44D3-A904-DDB9A779BFD9</Id>
  <Name>Uniclass2 Systems</Name>
  <IdDescriptionSeparator> : </IdDescriptionSeparator>
  <SharedParamName>AcUniclass2</SharedParamName>

  <Classification Id="SP" Description="Spaces" AvailableForRvtCats="OST_Rooms, OST_MEPSpaces">
    <Classification Id="sp.25" Description="Administrative, commercial and protective service spaces"/>
    <Classification Id="sp.30" Description="Educational, scientific and information spaces">
      <Classification Id="sp.30.10.01" Description="adult education classrooms"/>
      <Classification Id="sp.30.10.04" Description="art studios"/>
      ...
      <Classification Id="sp.30.10.97" Description="Woodwork classrooms"/>
    </Classification>
    <Classification Id="sp.35" Description="Industrial spaces">
    </Classification>
    ...
    <Classification Id="sp.65" Description="Sanitary, cleaning, maintenance and storage spaces">
      <Classification Id="sp.65.10" Description="general circulation spaces"/>
        <Classification Id="sp.65.80.96" Description="Wall services voids"/>
      </Classification>
    </Classification>
</RvtClassification>
```

Classification Tool for Revit – Manager UI Dialog



Classification Tool for Revit

- Live Demo…

What is COBie?

COBie

Construction Operations Building Information Exchange

What is COBie?

- Internationally recognized data exchange standard
- Exchange building systems information between design & construction with building owners
- Format for delivering construction handover data

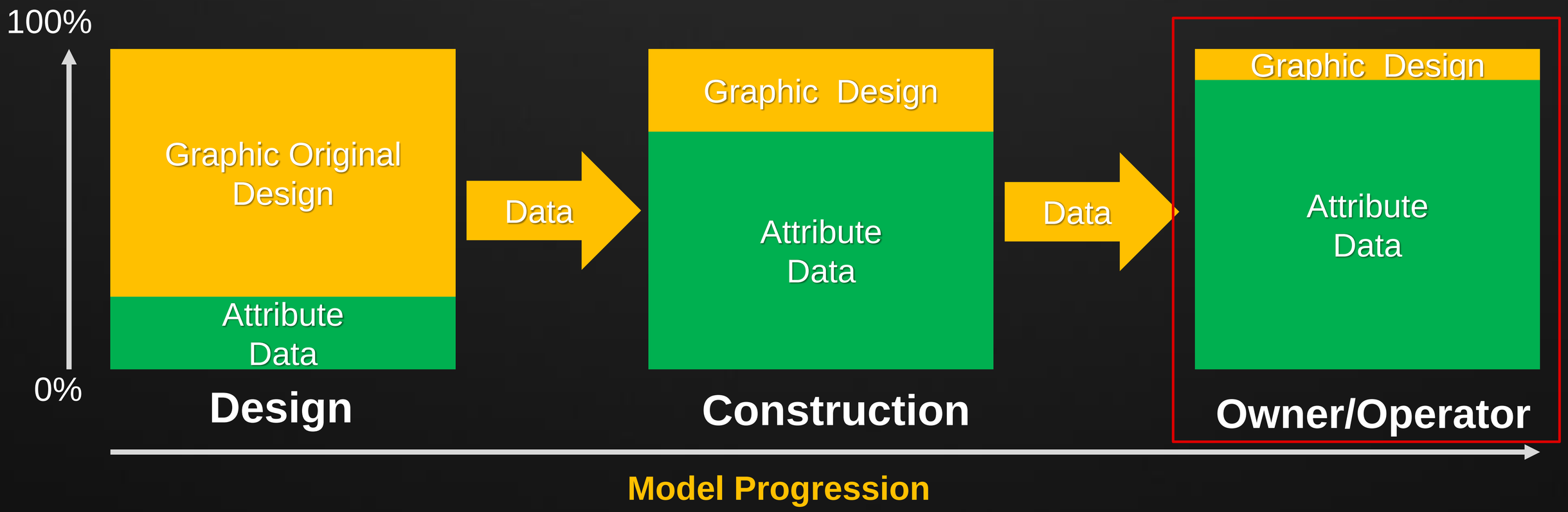
The Problem

Lack of Consistent and Useful Deliverables to Owners for O&M

- Support the operations, maintenance, and the management of the facilities
  - Commissioning
  - Facilities Management
  - Asset Management
  - CMMS
  - Document Management
- Facilitate of documentation handover
  - equipment lists
  - product data sheets
  - Warranties
  - spare part lists
  - preventive maintenance schedules

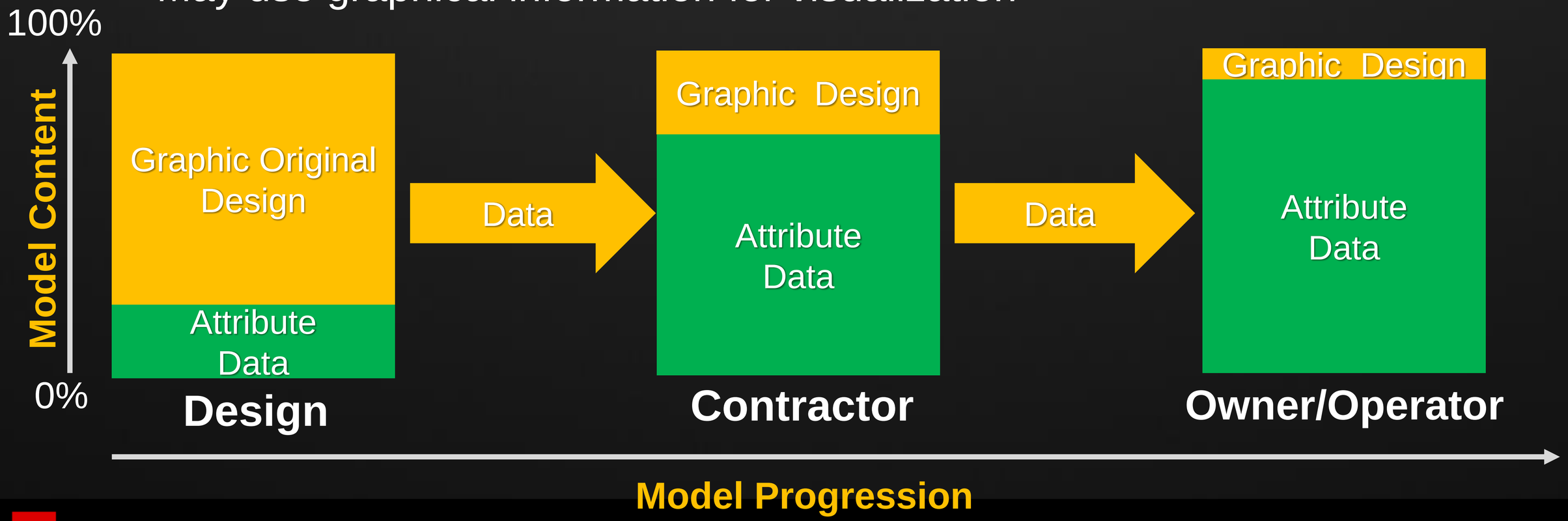
Graphic / Attribute Data Creation and Editing

- COBie is primarily textual information
- Organized data in electronic form

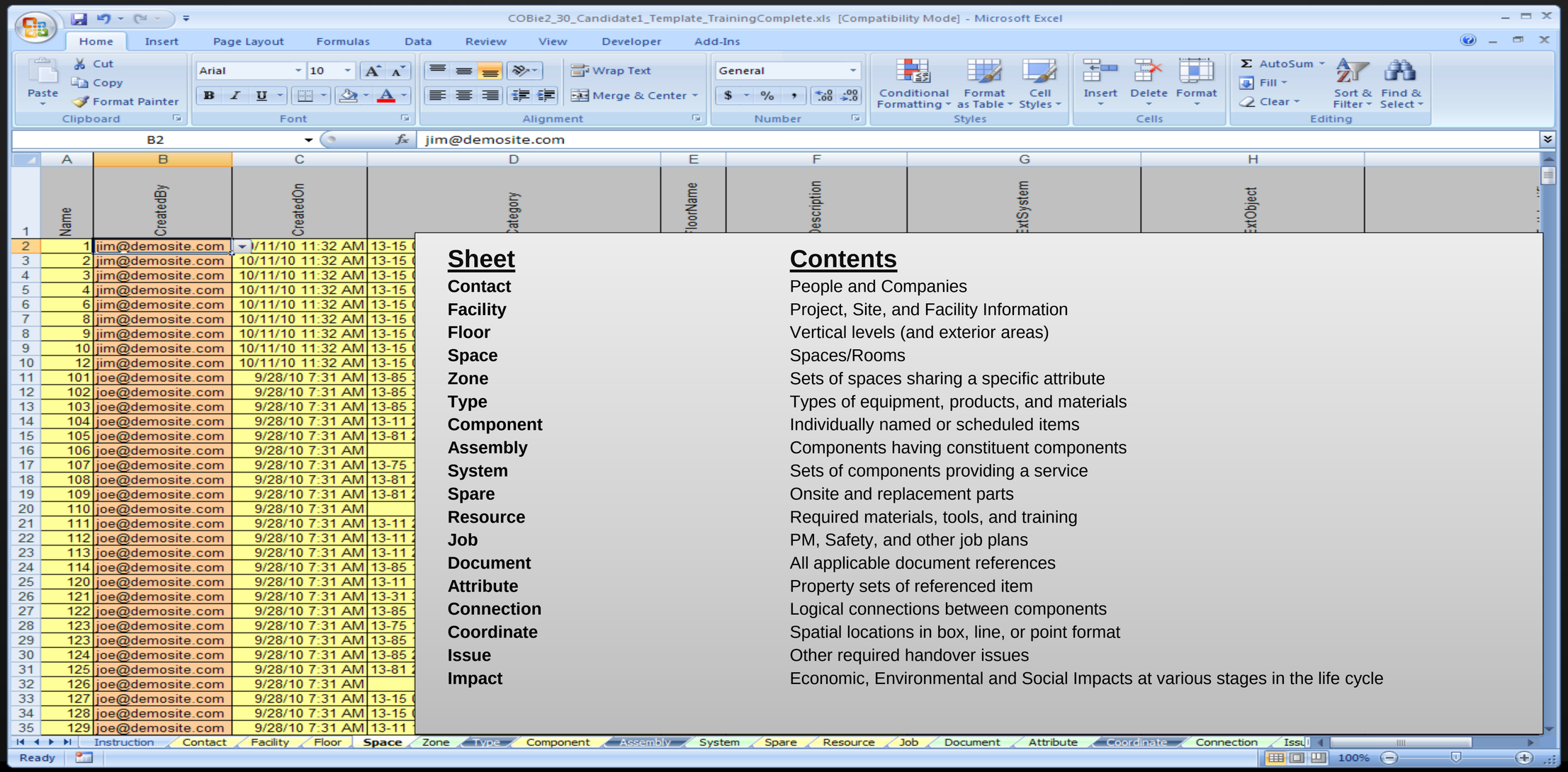


Graphic / Attribute Data Creation and Editing

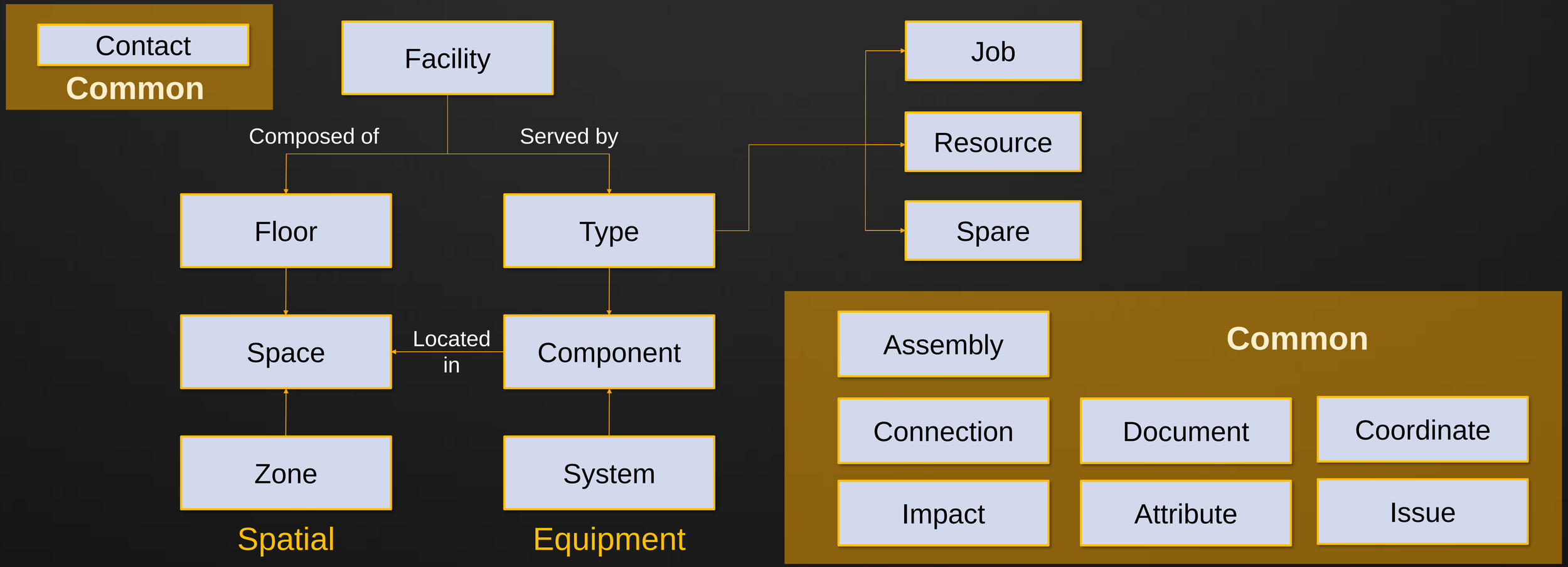
- Attributes Increase as model progresses
- COBie is primarily textual information
- Organized data in electronic form
  - May use graphical information for visualization



COBie Structure



COBie Sheets



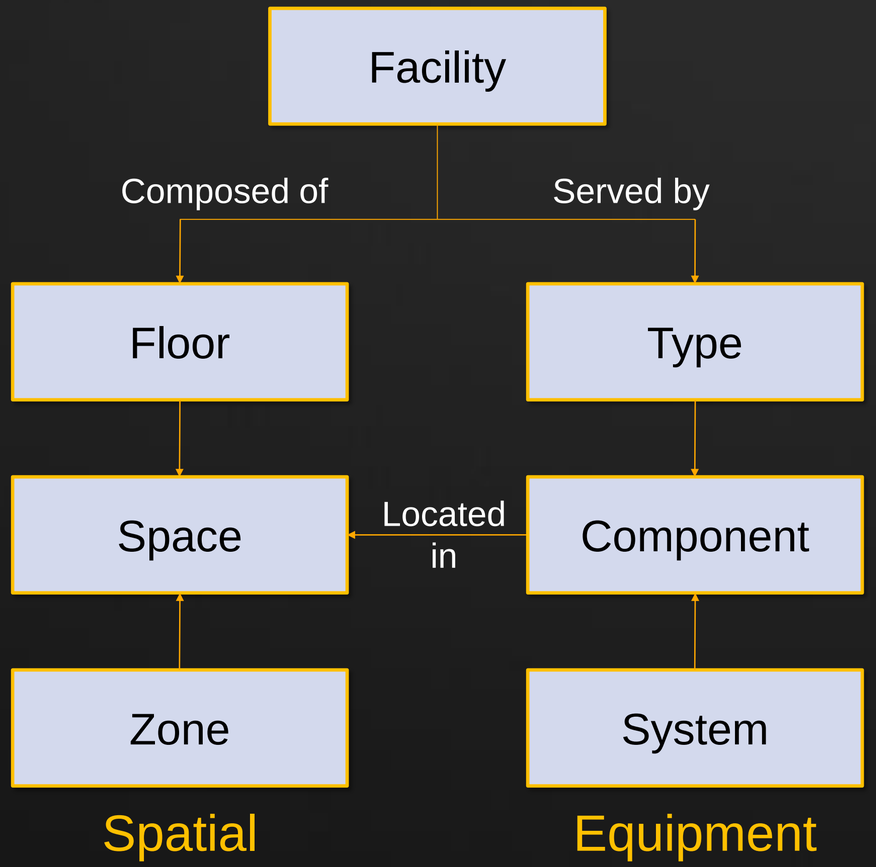
COBie Worksheets 1 through 8

COBie Worksheets 9 through 18

Project Lifecycle

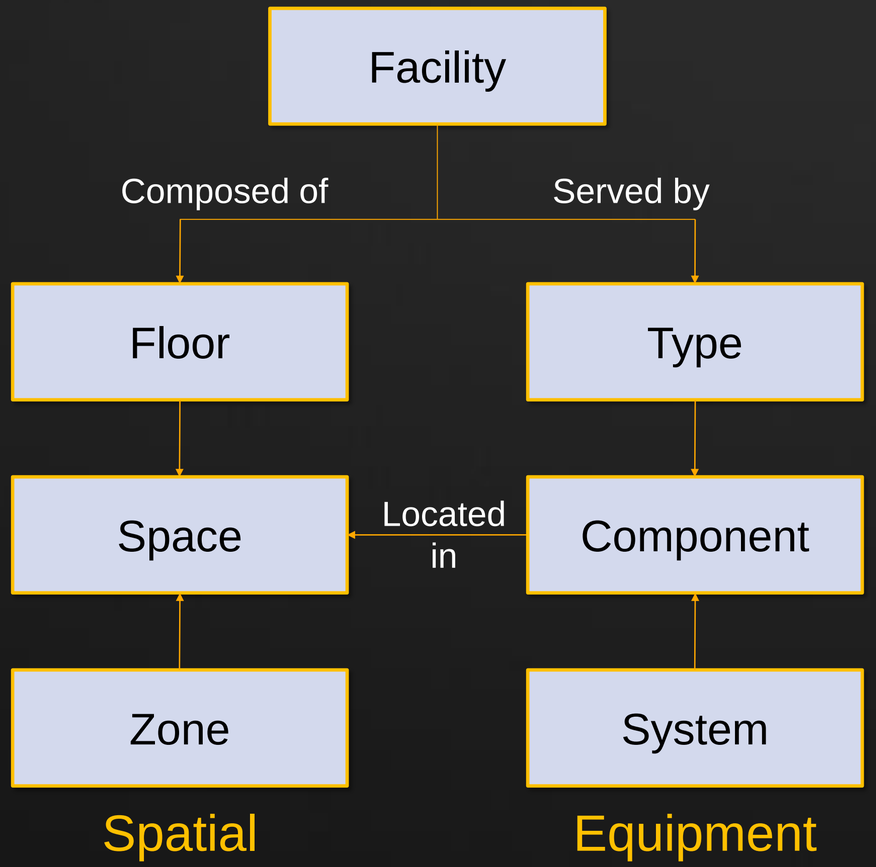
Design + Documentation → *Construction* → *Project Delivery*

COBie Sheets



Worksheets/data typically created or maintained in Revit Model

COBie Sheets



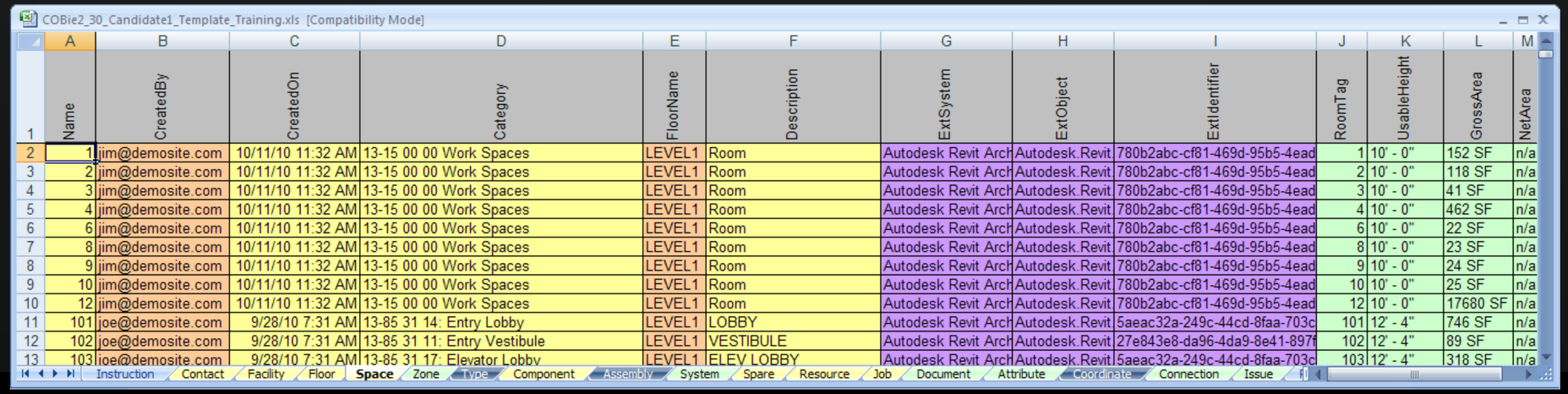
Additional data typically derived from Revit Model

Coordinates

Attributes

COBie Organization

- One worksheet for each info type
- Worksheets have standard format
- Color coded
- Pick-lists link information on sheets
- Documents listed as references to external files
- Can be customized



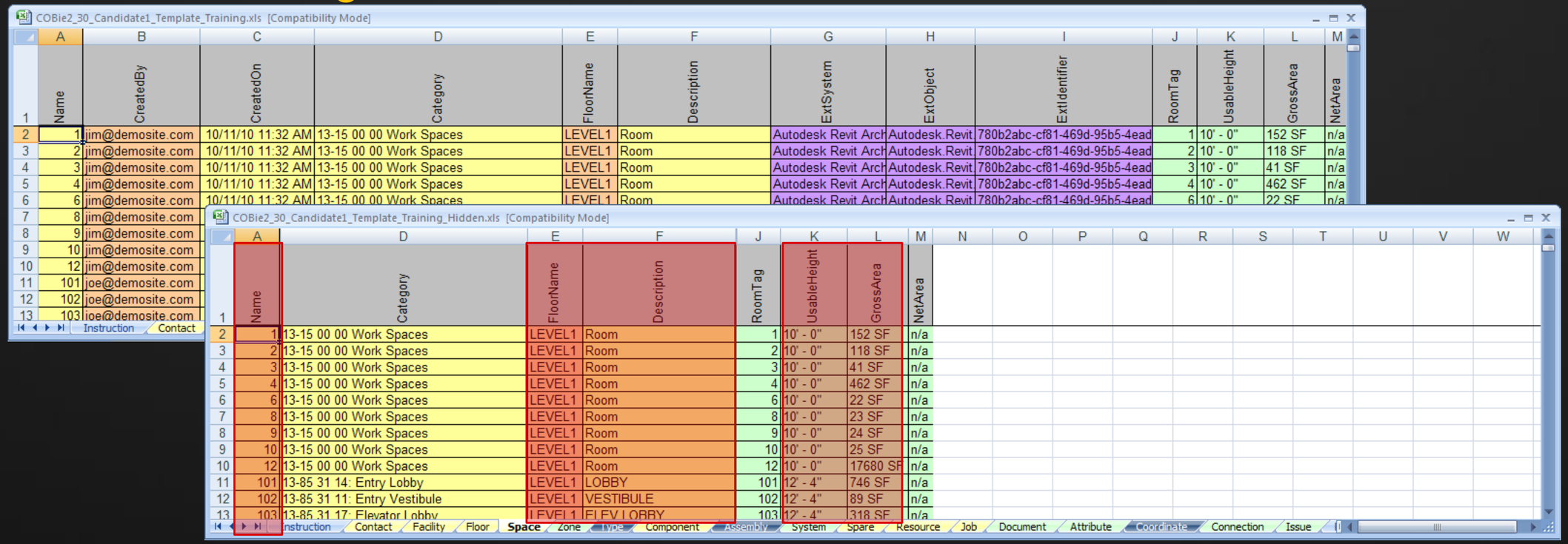
COBie2_30_Candidate1_Template_Training.xls [Compatibility Mode]

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Name	CreatedBy	CreatedOn	Category	FloorName	Description	ExtSystem	ExtObject	ExtIdentifier	RoomTag	UsableHeight	GrossArea	NetArea
2	1	jim@demosite.com	10/11/10 11:32 AM	13-15 00 00 Work Spaces	LEVEL1	Room	Autodesk Revit Arch	Autodesk.Revit	780b2abc-cf81-469d-95b5-4ead	1	10' - 0"	152 SF	n/a
3	2	jim@demosite.com	10/11/10 11:32 AM	13-15 00 00 Work Spaces	LEVEL1	Room	Autodesk Revit Arch	Autodesk.Revit	780b2abc-cf81-469d-95b5-4ead	2	10' - 0"	118 SF	n/a
4	3	jim@demosite.com	10/11/10 11:32 AM	13-15 00 00 Work Spaces	LEVEL1	Room	Autodesk Revit Arch	Autodesk.Revit	780b2abc-cf81-469d-95b5-4ead	3	10' - 0"	41 SF	n/a
5	4	jim@demosite.com	10/11/10 11:32 AM	13-15 00 00 Work Spaces	LEVEL1	Room	Autodesk Revit Arch	Autodesk.Revit	780b2abc-cf81-469d-95b5-4ead	4	10' - 0"	462 SF	n/a
6	6	jim@demosite.com	10/11/10 11:32 AM	13-15 00 00 Work Spaces	LEVEL1	Room	Autodesk Revit Arch	Autodesk.Revit	780b2abc-cf81-469d-95b5-4ead	6	10' - 0"	22 SF	n/a
7	8	jim@demosite.com	10/11/10 11:32 AM	13-15 00 00 Work Spaces	LEVEL1	Room	Autodesk Revit Arch	Autodesk.Revit	780b2abc-cf81-469d-95b5-4ead	8	10' - 0"	23 SF	n/a
8	9	jim@demosite.com	10/11/10 11:32 AM	13-15 00 00 Work Spaces	LEVEL1	Room	Autodesk Revit Arch	Autodesk.Revit	780b2abc-cf81-469d-95b5-4ead	9	10' - 0"	24 SF	n/a
9	10	jim@demosite.com	10/11/10 11:32 AM	13-15 00 00 Work Spaces	LEVEL1	Room	Autodesk Revit Arch	Autodesk.Revit	780b2abc-cf81-469d-95b5-4ead	10	10' - 0"	25 SF	n/a
10	12	jim@demosite.com	10/11/10 11:32 AM	13-15 00 00 Work Spaces	LEVEL1	Room	Autodesk Revit Arch	Autodesk.Revit	780b2abc-cf81-469d-95b5-4ead	12	10' - 0"	17680 SF	n/a
11	101	joe@demosite.com	9/28/10 7:31 AM	13-85 31 14: Entry Lobby	LEVEL1	LOBBY	Autodesk Revit Arch	Autodesk.Revit	5aeac32a-249c-44cd-8faa-703c	101	12' - 4"	746 SF	n/a
12	102	joe@demosite.com	9/28/10 7:31 AM	13-85 31 11: Entry Vestibule	LEVEL1	VESTIBULE	Autodesk Revit Arch	Autodesk.Revit	27e843e8-da96-4da9-8e41-897f	102	12' - 4"	89 SF	n/a
13	103	joe@demosite.com	9/28/10 7:31 AM	13-85 31 17: Elevator Lobby	LEVEL1	ELEV LOBBY	Autodesk Revit Arch	Autodesk.Revit	5aeac32a-249c-44cd-8faa-703c	103	12' - 4"	318 SF	n/a

Instruction | Contact | Facility | Floor | **Space** | Zone | Type | Component | Assembly | System | Spare | Resource | Job | Document | Attribute | Coordinate | Connection | Issue

COBie Excel Spreadsheet

Understanding the Structure and Fields



COBie2_30_Candidate1_Template_Training.xls [Compatibility Mode]

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Name	CreatedBy	CreatedOn	Category	FloorName	Description	ExtSystem	ExtObject	ExtIdentifier	RoomTag	UsableHeight	GrossArea	NetArea
2	1	jim@demosite.com	10/11/10 11:32 AM	13-15 00 00 Work Spaces	LEVEL1	Room	Autodesk Revit Arch	Autodesk.Revit	780b2abc-cf81-469d-95b5-4ead	1	10' - 0"	152 SF	n/a
3	2	jim@demosite.com	10/11/10 11:32 AM	13-15 00 00 Work Spaces	LEVEL1	Room	Autodesk Revit Arch	Autodesk.Revit	780b2abc-cf81-469d-95b5-4ead	2	10' - 0"	118 SF	n/a
4	3	jim@demosite.com	10/11/10 11:32 AM	13-15 00 00 Work Spaces	LEVEL1	Room	Autodesk Revit Arch	Autodesk.Revit	780b2abc-cf81-469d-95b5-4ead	3	10' - 0"	41 SF	n/a
5	4	jim@demosite.com	10/11/10 11:32 AM	13-15 00 00 Work Spaces	LEVEL1	Room	Autodesk Revit Arch	Autodesk.Revit	780b2abc-cf81-469d-95b5-4ead	4	10' - 0"	462 SF	n/a
6	6	jim@demosite.com	10/11/10 11:32 AM	13-15 00 00 Work Spaces	LEVEL1	Room	Autodesk Revit Arch	Autodesk.Revit	780b2abc-cf81-469d-95b5-4ead	6	10' - 0"	22 SF	n/a
7	8	jim@demosite.com											
8	9	jim@demosite.com											
9	10	jim@demosite.com											
10	12	jim@demosite.com											
11	101	joe@demosite.com											
12	102	joe@demosite.com											
13	103	joe@demosite.com											

Instruction | Contact

COBie2_30_Candidate1_Template_Training_Hidden.xls [Compatibility Mode]

	A	D	E	F	J	K	L	M
1	Name	Category	FloorName	Description	RoomTag	UsableHeight	GrossArea	NetArea
2	1	13-15 00 00 Work Spaces	LEVEL1	Room	1	10' - 0"	152 SF	n/a
3	2	13-15 00 00 Work Spaces	LEVEL1	Room	2	10' - 0"	118 SF	n/a
4	3	13-15 00 00 Work Spaces	LEVEL1	Room	3	10' - 0"	41 SF	n/a
5	4	13-15 00 00 Work Spaces	LEVEL1	Room	4	10' - 0"	462 SF	n/a
6	6	13-15 00 00 Work Spaces	LEVEL1	Room	6	10' - 0"	22 SF	n/a
7	8	13-15 00 00 Work Spaces	LEVEL1	Room	8	10' - 0"	23 SF	n/a
8	9	13-15 00 00 Work Spaces	LEVEL1	Room	9	10' - 0"	24 SF	n/a
9	10	13-15 00 00 Work Spaces	LEVEL1	Room	10	10' - 0"	25 SF	n/a
10	12	13-15 00 00 Work Spaces	LEVEL1	Room	12	10' - 0"	17680 SF	n/a
11	101	13-85 31 14: Entry Lobby	LEVEL1	LOBBY	101	12' - 4"	746 SF	n/a
12	102	13-85 31 11: Entry Vestibule	LEVEL1	VESTIBULE	102	12' - 4"	89 SF	n/a
13	103	13-85 31 17: Elevator Lobby	LEVEL1	ELEV LOBBY	103	12' - 4"	318 SF	n/a

Instruction | Contact | Facility | Floor | Space | Zone | Type | Component | Assembly | System | Spare | Resource | Job | Document | Attribute | Coordinate | Connection | Issue

Color Legend
required
required foreign key
required if mapping to authoring software
required if specified
regional, owner, or product specific data

Fields Contained in Each Sheet	
CreatedBy	Authors Identity
CreatedOn	creation/publication date
ExtSystem	Name of Software
ExtObject	Object Name in Software
ExtIdentifier	Unique ID Generated by Software

Picklists

Data Validation and consistency

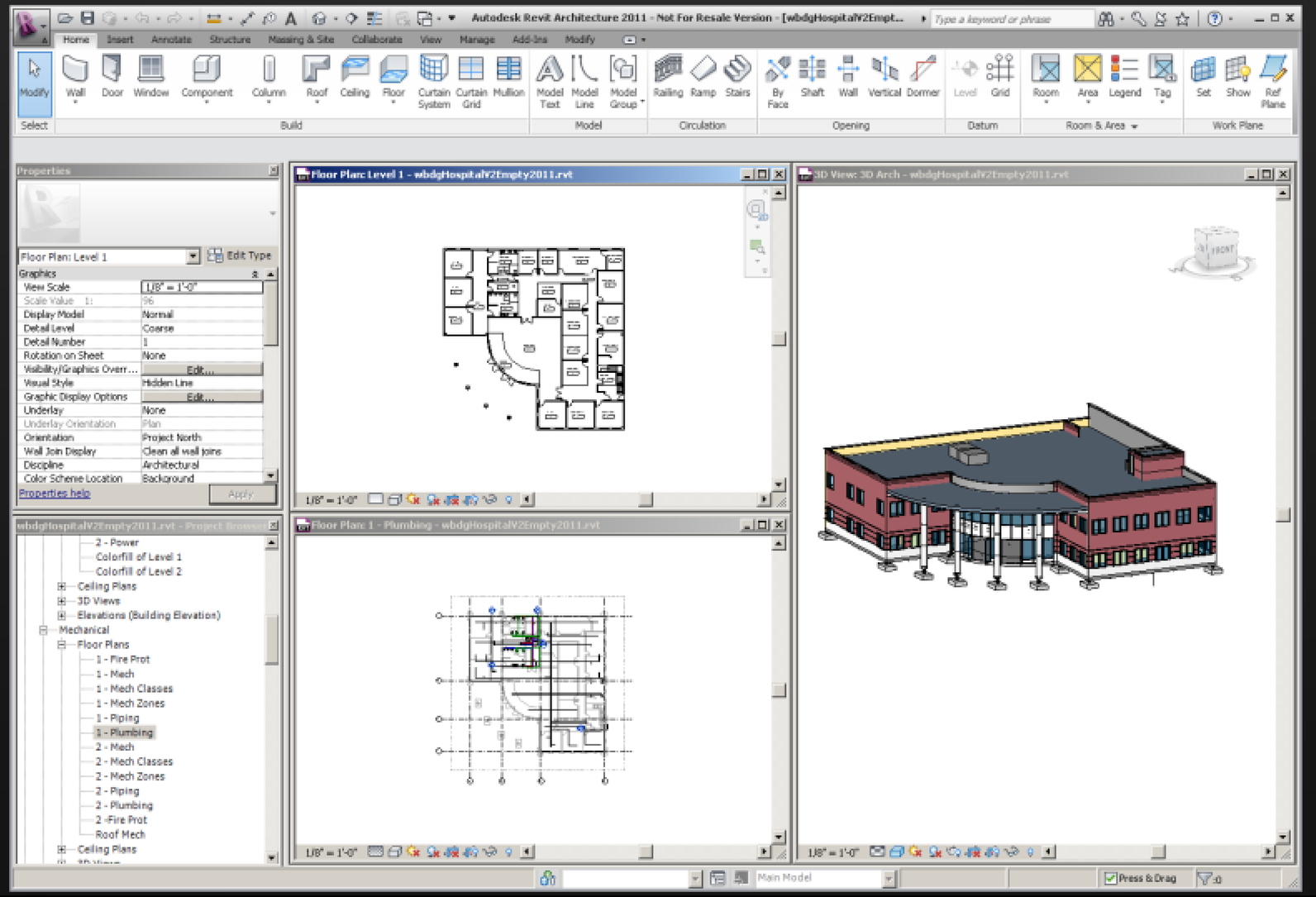
- Data validation
- Limiting values which can be selected for certain columns

	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	Category-Role	CoordinateSheet	ConnectionType	CoordinateType	DocumentType	DurationUnit	FloorType	IssueCategory	IssueChance	IssueImpact	IssueRisk	JobStatusType	JobType
2	34-11: Management	Component	Control	point	Preconstruction Submittals	as required	Site	Change	Has Occurred	Very High	Very High	Not Yet Started	Adjustment
3	34-11 11: Executive Management	Floor	Flow	line-end-one	Shop Drawings	day	Floor	Claim	High	High	High	Started	Calibration
4	34-11 11 11: Chief Executive	Space	Return	line-end-two	Product Data	minute	Roof	Coordination	Moderate	Moderate	Moderate	Completed	Emergency
5	34-11 11 21: Vice President		Supply	box-lowerleft	Samples	month		Environmental	Low	Low	Low		Inspection
6	34-11 11 31: Chairperson		Structural	box-upperright	Design Data	quarter		Function	Unknown	Unknown	Unknown		Operation
7	34-11 11 41: Board Member				Test Reports	week		IndoorAirQuality					PM
8	34-11 11 51: Partner				Certificates	year		Installation					Safety
9	34-11 21: Middle-Management				Manufacturer Instructions			RFI					ShutDown
10	34-11 21 11: Supervisor				Manufacturer Field Reports			Safety					StartUp
11	34-11 21 21: Coordinator				Operation and Maintenance			Specification					Testing
12	34-11 21 31: Trainer				Closeout Submittals								Trouble
13	34-21: Planning Roles				Contract Drawings								
14	34-21 11: Developer				Design Review Comment								

Assembly | System | Spare | Resource | Job | Document | Attribute | Coordinate | Connection | Issue | PickLists

From Revit to COBie

Putting it all together

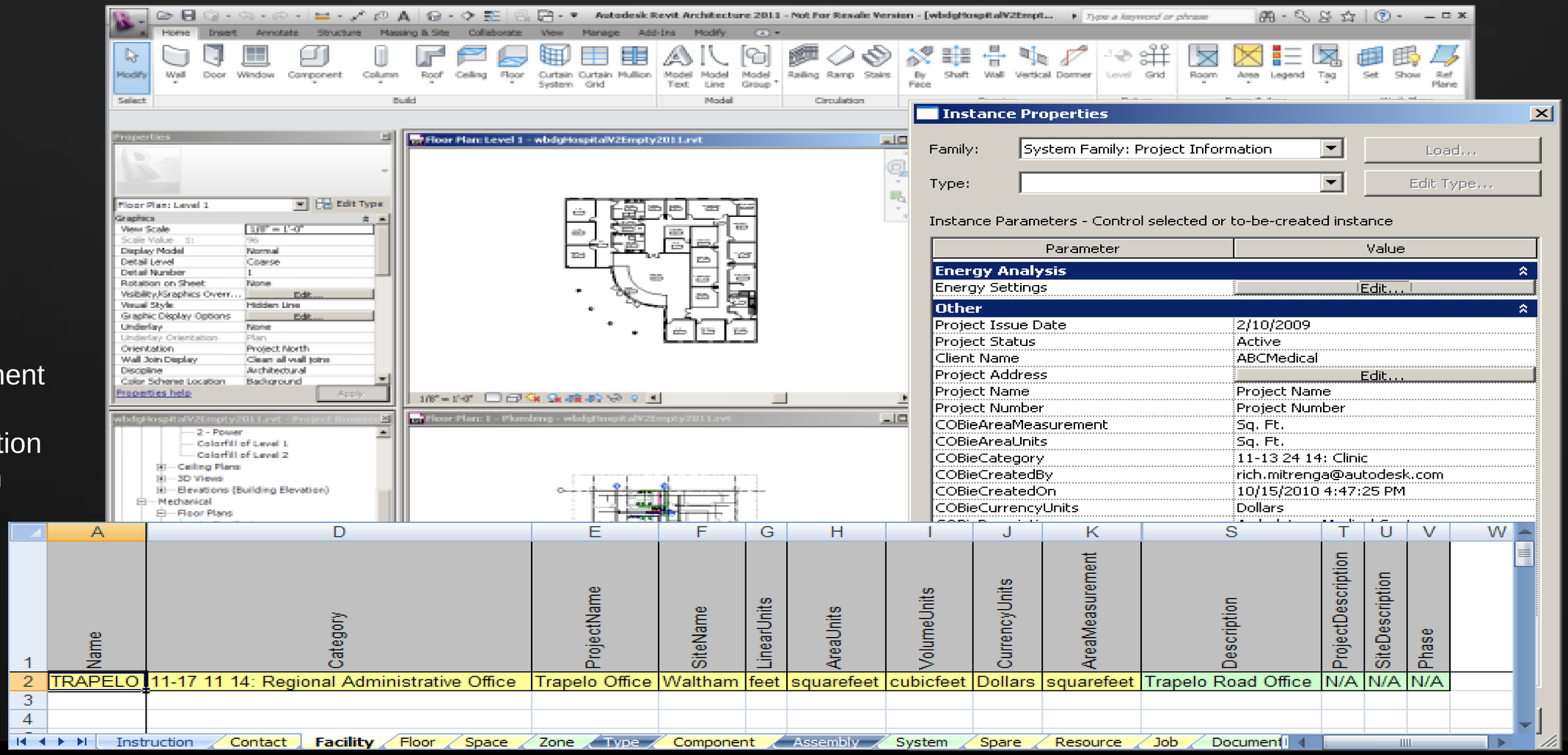


COBie Facility Tab

Facility Tab ⇔ Revit Project Info

Facility

- Name
- Category
- Project Name
- Site Name
- Linear Units
- Area Units
- Volume Units
- Currency Units
- Area Measurement
- Description
- Project Description
- Site Description
- Phase



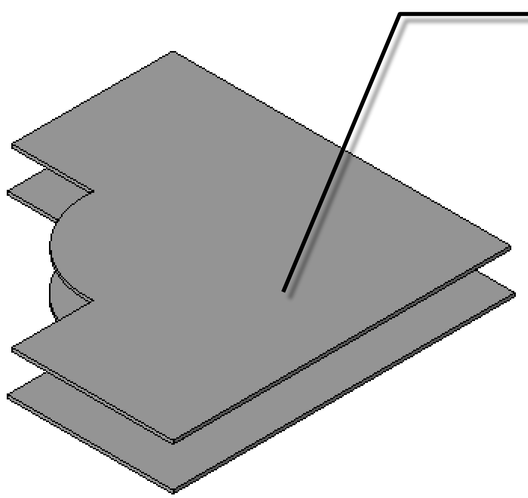
COBie Data Structure – Spatial

Floor Tab <-> Revit Level

Floor

Name
Category
Description
Elevation
Height

- **Floor Data**
  - Name
  - Gross Area
- **Revit Level**



LEVEL2
Floor
2nd Floor
218.67 SF
13.27 FT
…

	A	D	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	Name	Category	Description	Elevation	Height										
2	TOSCRN	Roof	T.O. Screen Wall	182.67	11.33										
3	LEVELB	Floor	Basement	194.00	12.33										
4	LEVEL1	Floor	1st Floor	206.33	12.33										
5	LEVEL2	Floor	2nd Floor	218.67	13.21										
6	LEVEL3	Floor	3rd Floor	231.88	9.13										
7	TOSTEEL	Roof	T.O. Steel	241.00	0.00										

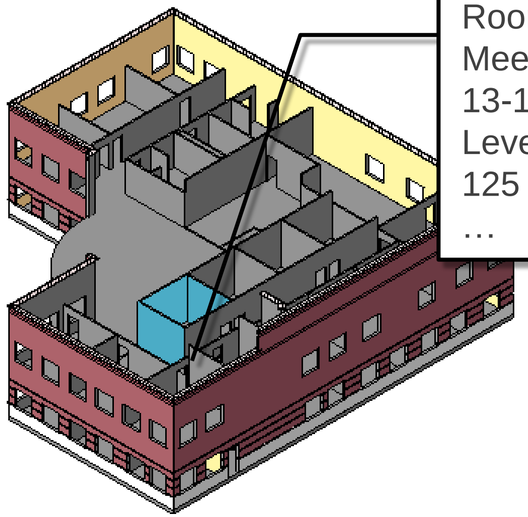
Instruction | Contact | Facility | **Floor** | Space | Zone | Type | Component | Assembly | System | Spare | Resource | Job | Document

COBie Data Structure – Spatial

Space Tab ⇔ Revit Room / Revit MEP Space

Space

- Name
- Category
- Floor Name
- Description
- Room Tag
- Usable Height
- Gross Area
- Net Area



Room 211
Meeting Room A
13-11 21 17: Conference Room
Level2
125 SF
…

	A	E	F	J	K	L	M	N	O	P	Q	R	S	T	U	V
1	Name	FloorName	Description	RoomTag	UsableHeight	GrossArea	NetArea									
2	1	LEVEL1	Room	1	10' - 0"	152 SF	n/a									
3	2	LEVEL1	Room	2	10' - 0"	118 SF	n/a									
4	3	LEVEL1	Room	3	10' - 0"	41 SF	n/a									
5	4	LEVEL1	Room	4	10' - 0"	462 SF	n/a									
6	6	LEVEL1	Room	6	10' - 0"	22 SF	n/a									

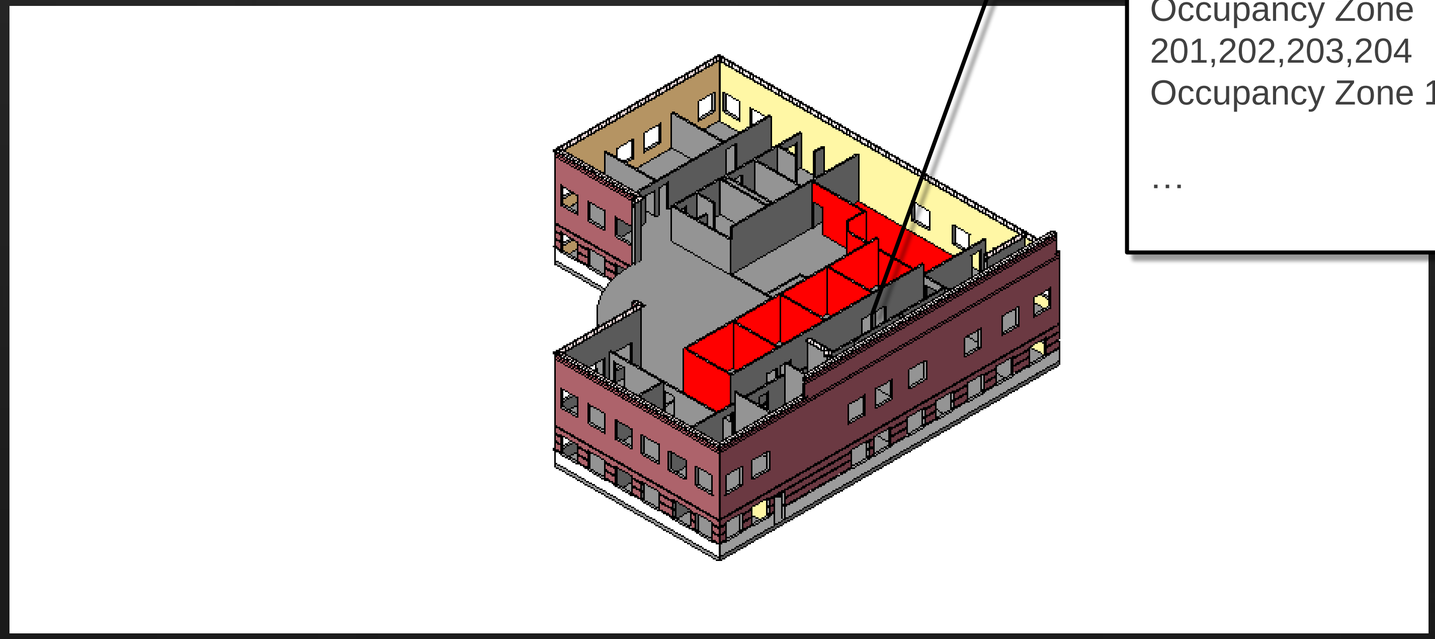
Instruction | Contact | Facility | Floor | Space | Zone | Component | System | Spare | Resource | Job | Document

COBie Data Structure – Spatial

Zone Tab

Zone

Name
Category Space Names
Description



OCCZone1
Occupancy Zone
201,202,203,204
Occupancy Zone 1

…

	A	D	E	I	J	K	L	M	N	O	P	Q	R
1	Name	Category	SpaceNames	Description									
2	OCCZone1	Occupancy Zone	233,234,235	Occupancy Zone 1									
3	OCCZone2	Occupancy Zone	210,212,215	Occupancy Zone 2									
4	OCCZone3	Occupancy Zone	220,221,223,225	Occupancy Zone 3									
5													
6													

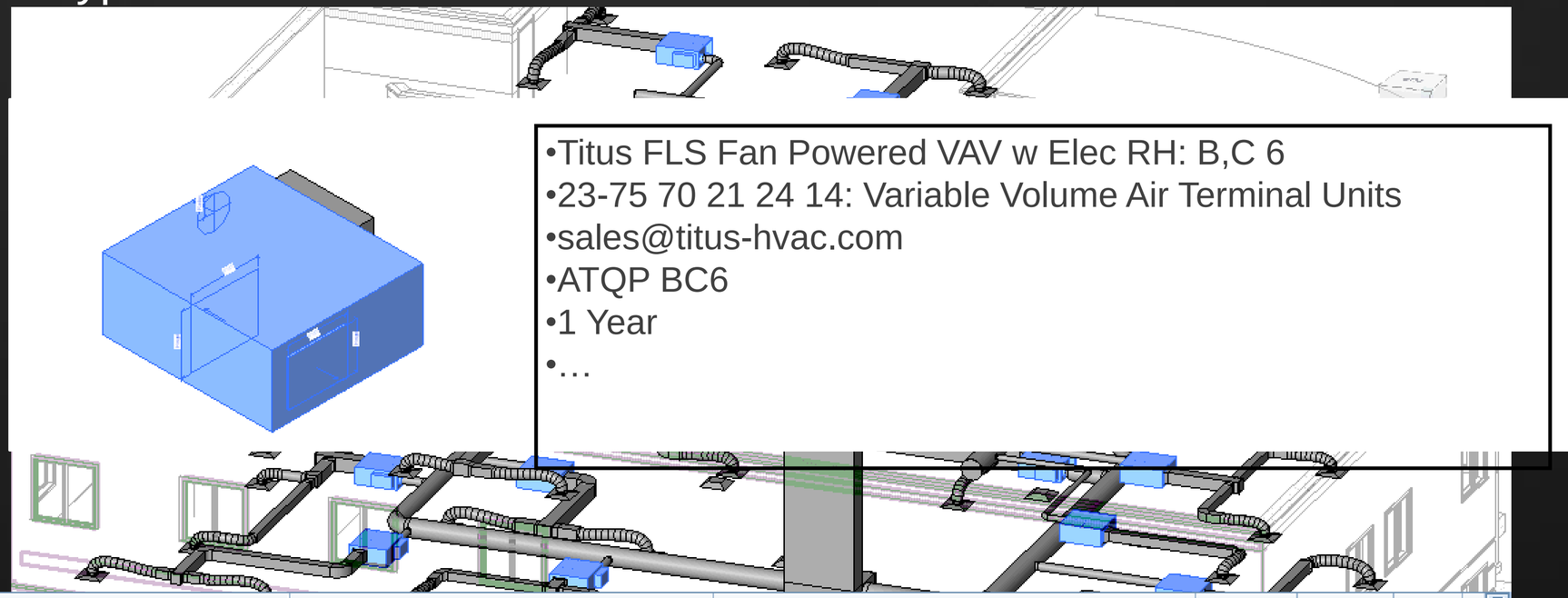
Instruction | Contact | Facility | Floor | Space | Zone | Type | Component | Assembly | System | Spare | Resource | Job | Document

COBie Data Structure – Equipment

Type Tab ⇔ Revit Family Type

One record for each Asset Type

Type
- Name
- Category
- Description
- Asset Type
- Manufacturer
- Model Number
- Warranty Guarantor
- Warranty Duration
- Warranty Duration Unit
- Replacement Cost
- Expected Life
- Duration Unit
- Warranty Description



- Titus FLS Fan Powered VAV w Elec RH: B,C 6
- 23-75 70 21 24 14: Variable Volume Air Terminal Units
- sales@titus-hvac.com
- ATQP BC6
- 1 Year
- …

	A	D	E	F	G	H
1	Name	Category	Description	AssetType	Manufacturer	ModelNumber
2	Centrifugal Fan - Inline - Belt Drive: 1500 C	23-75 35 17 27: Centrifugal Fans	Centrifugal Fan - Inline - Belt Drive: 1500 CFM	Fixed	bob@trar	C577
3	Centrifugal Fan - Inline - Belt Drive: 4500 C	23-75 35 17 27: Centrifugal Fans	Centrifugal Fan - Inline - Belt Drive: 4500 CFM	Fixed	bob@trar	C578
4	Exhaust Ventilator - Downblast: Standard	23-75 35 21 21: Power Ventilators	Exhaust Ventilator - Downblast: Standard	Fixed	bob@trar	C579
5	KS - big crac: KS - CRAC - LIEBERT CHALLEN	23-75 10 24 21 27: Unitary Air Conditioni	CRAC - LIEBERT CHALLENGER - 5 TON	Fixed	bob@trar	C580
6	KS - crac cond: KS - Air Cooled Condenser	23-75 10 24 21 11: Refrigerant Condensir	Air Cooled Condenser - 5 ton	Fixed	bob@trar	C581
7	KS - crac cond: KS - Air Cooled Condenser	23-75 10 24 21 11: Refrigerant Condensir	Air Cooled Condenser - 15 ton		bob@trar	C582

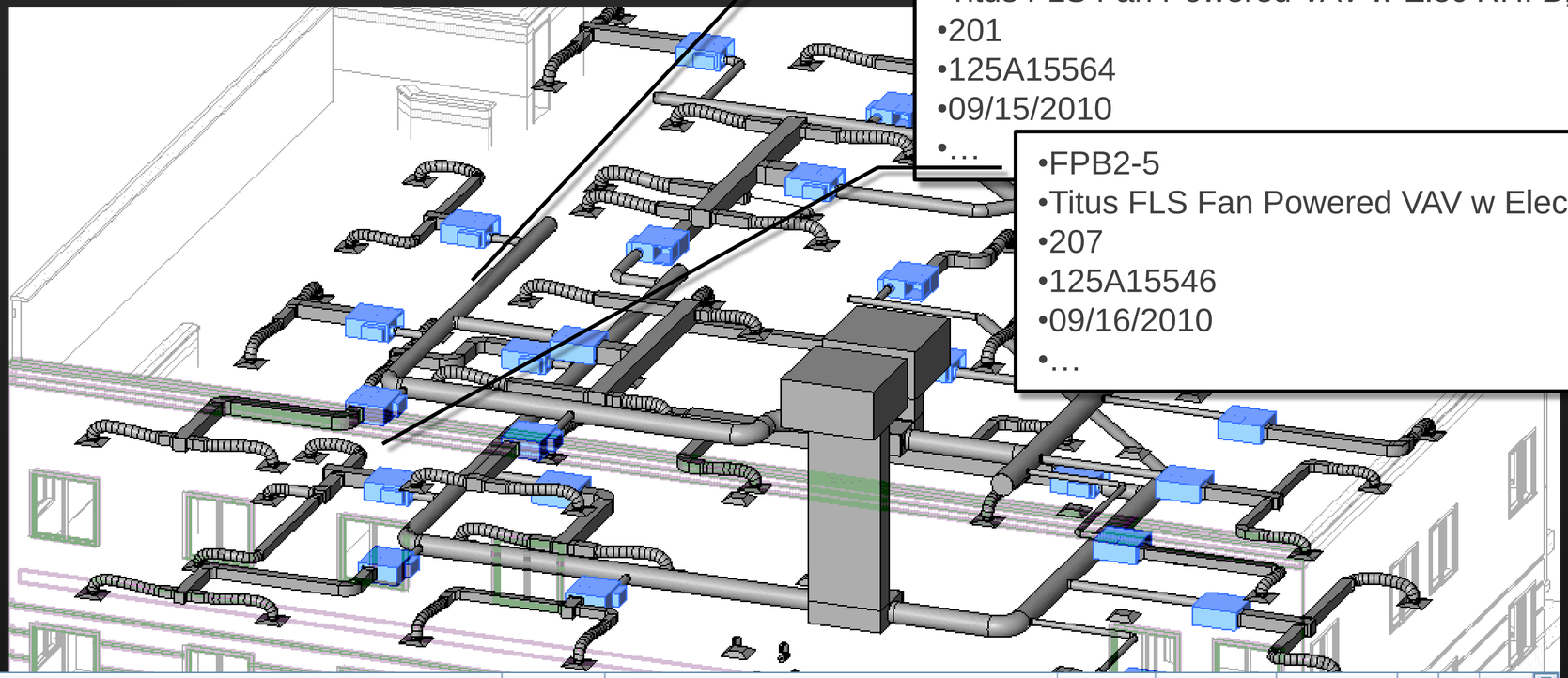
Instruction | Contact | Facility | Floor | Space | Zone | **Type** | Component | System | Spare | Resource | Job | Document | Attribute

COBie Data Structure – Equipment

Component Tab ⇔ Revit Family Instance

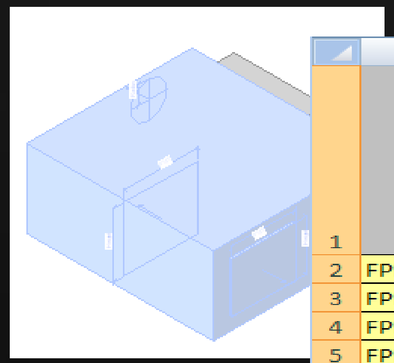
Component

- Name
- Type Name
- Space Names
- Description
- Serial Number
- Installation Date
- Warranty Start Date
- Tag Number
- Bar Code
- Asset Identifier



- FPB2-1 v
- Titus FLS Fan Powered VAV w Elec RH: B,C 6
- 201
- 125A15564
- 09/15/2010
- …

- FPB2-5
- Titus FLS Fan Powered VAV w Elec RH: B,C 6
- 207
- 125A15546
- 09/16/2010
- …



	A	D	E	F	J	K	L	M	N	O
1	Name	TypeName	Space	Description	SerialNumber	InstallationDate	WarrantyStartDate	TagNumber	BarCode	AssetIdentifier
2	FPB2-1	Titus FLS Fan Powered VAV w Elec RH: B,C 8	175	Fan Powered VAV w Elec RH: B,C 8	1231234	9/15/2010	9/15/2010			
3	FPB2-2	Titus FLS Fan Powered VAV w Elec RH: B,C 12	179	Fan Powered VAV w Elec RH: B,C 12	1231235	9/15/2010	9/15/2010			
4	FPB2-3	Titus FLS Fan Powered VAV w Elec RH: B,C 12	185	Fan Powered VAV w Elec RH: B,C 12	1231236	9/15/2010	9/15/2010			
5	FPB2-4	Titus FLS Fan Powered VAV w Elec RH: B,C 6	221	Fan Powered VAV w Elec RH: B,C 6	1231237	9/15/2010	9/15/2010			
6	FPB2-5	Titus FLS Fan Powered VAV w Elec RH: B,C 12	180	Fan Powered VAV w Elec RH: B,C 12	1231238	9/15/2010	9/15/2010			

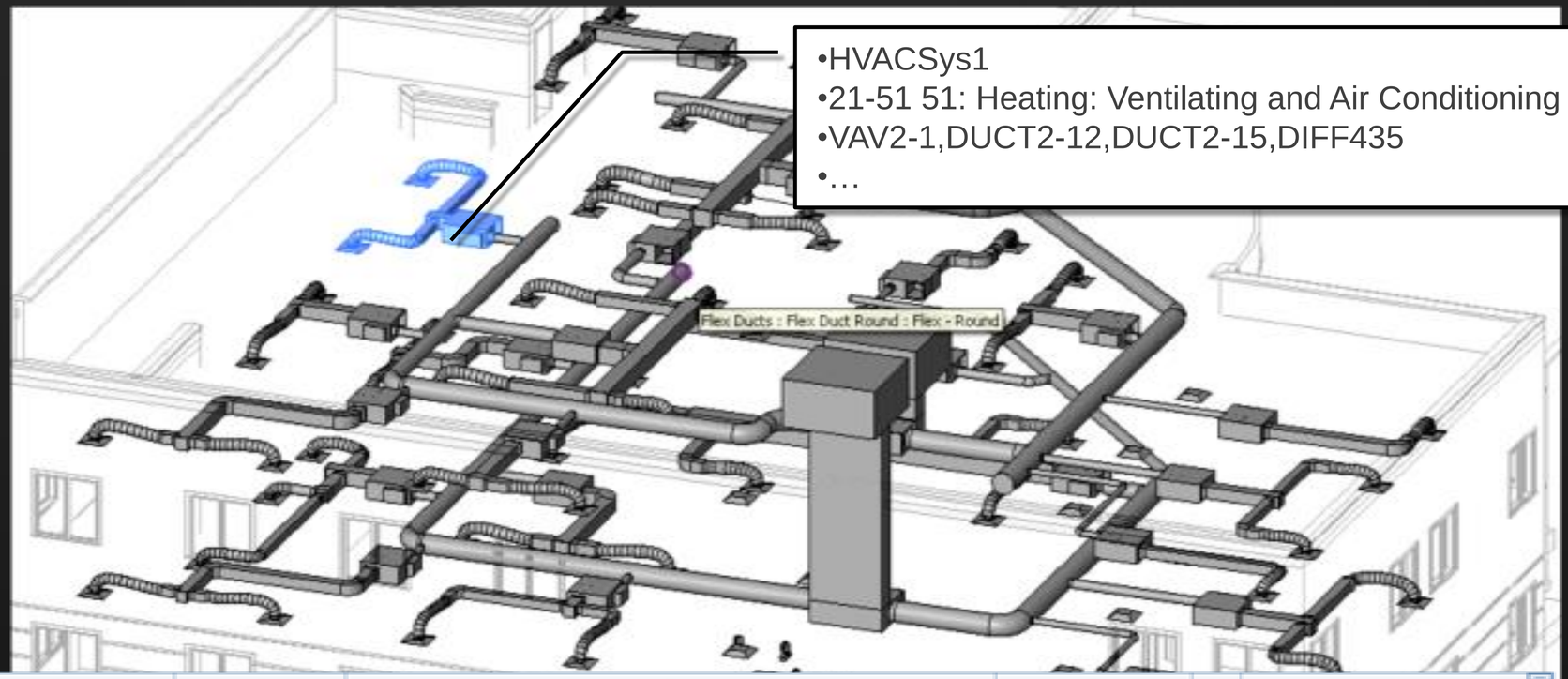
Instruction | Contact | Facility | Floor | Space | Zone | Type | **Component** | System | Spare | Resource | Job | Document | Attribute

COBie Data Structure – Equipment

Systems

System

Name
Category
Component Names
Description



- HVACSys1
- 21-51 51: Heating: Ventilating and Air Conditioning (HVAC)
- VAV2-1,DUCT2-12,DUCT2-15,DIFF435
- …

	A	B	C	D	E	H	I
1	Name	CreatedBy	CreatedOn	Category	ComponentNames	ExtIdentifier	Description
2	FPBSYS1	jim@demosite.com	9/28/2010 7:31	21-51 51: Heating: Ventilating and Air Conditioning (HVAC)	FPB1-13,FPB1-15	N/A	FPB System 1
3							
4							
5							
6							

Instruction | Contact | Facility | Floor | Space | Zone | Type | Component | System | Spare | Resource | Job | Document | Attribute

Customization

- Pick list customization
  - Headings may not be changed
  - Green pick lists may be updated based on local/language requirements
  - Yellow lists map to COBie requirements and may not be changed
  - Purple lists map the IFC model and may not be changed
- Regional classification schema may be substituted for pick lists
  - BOMA, FICM etc
  - International Standards
- Regional, owner, or product specific data may be added as new columns to the right of standard template columns
  - Finishes, Occupancy, etc.
- Custom properties
  - “Attributes” table

Additional Attributes

Assigning Specific Equipment Information

Air Handler Unit (AHU)

InsulationStandardClass
Reference
Frequency
PhaseAngle
PhaseReference
NumberOfPoles
HasProtectiveEarth
Capacity in BTU
Capacity in Tonnage
Capacity in CFM
Nominal cooling capacity in BTUH
Nominal cooling capacity in Tons
OutsideAirFlowrate
DualDeck
Economizer
Humidity Control
AirHandlerConstruction
AirHandlerFanCoilArrangement
Air Handler Unit Type
Air Handler Type of Heating
Air Handler Type of Cooling
Air Filter Type
Air Filter Change-out Schedule
Supply fan motor size in hp
Supply fan in cfm
Return motor size in hp
Return fan in cfm
VFD
Number of Belts
Size of Belts
Type of Belt (shape)

Valves

BodyMaterial
WaterInletTemperatureRange
WaterStorageCapacity
Maximum Operating Pressure
ValvePattern
ValveOperation
ValveMechanism
Type of Valve
Valve Body Material
Valve Size (Inches)
Number of Holes
Pressure Rating of Valve
Valve Movement
Valve Actuator
Location of shut-off valve
Maximum Water, Oil, Gas Rating
Access
Connection
Seat

Motors

Current
Power
Voltage
LockedRotorCurrent
ElectricMotorEfficiency
FrameSize
StartCurrentFactor
Motor Size
Frequency
PhaseAngle
PhaseReference
HasProtectiveEarth
MaximumPowerOutput
NumberOfPoles
IsGuarded
MotorEnclosureType
Rated load rpm
Duty rating
Location

COBie Data Structure – Common Sheets

Additional Attributes

Attribute

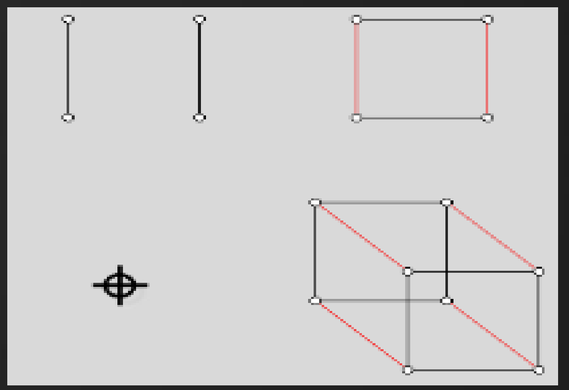
Name
Stage
SheetName
RowName
Value
Unit
Description

- Provides for additional attributes for a specific record in the spreadsheet

Name	Stage	SheetName	RowName	Value	Unit	Description
Area Served	As Built	Component	WH-1	Restroom, breakroom, janitor	n/a	
Basis of Design	As Built	Component	WH-1	Bradford White LD-30U3-1	n/a	
Cold Water Supply	As Built	Component	WH-1	Watts deta-20 expansion tank	n/a	
Input Power	As Built	Component	WH-1	1.5	kw	
op. Weight	As Built	Component	WH-1	331	lbs	
Recovery at 100° F Rise	As Built	Component	WH-1	6	GPH	
Storage Capacity	As Built	Component	WH-1	20	Gal	
Voltage	As Built	Component	WH-1	208/10	V	

COBie Data Structure – Common Sheets

Coordinate



Coordinate

Name
Category
SheetName
RowName
CoordinateXAxis
CoordinateYAxis
CoordinateZAxis
Area
Volume

- Provides simple location information

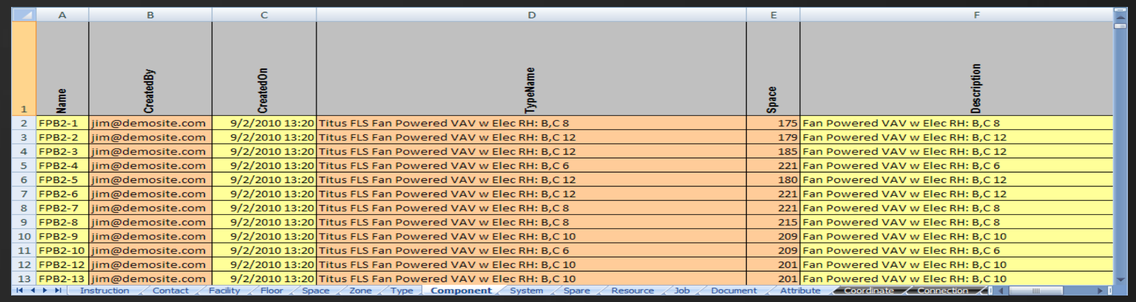
Simple Geometry

- 3-D Rectangle
- Square
- Line
- Point

Applied to

- Facility
- Floor
- Space
- Component

Additional COBie Sheets



	A	B	C	D	E	F
1	Name	CreatedBy	CreatedOn	TypeName	Space	Description
2	FPB2-1	jim@demosite.com	9/2/2010 13:20	Titus FLS Fan Powered VAV w Elec RH: B,C 8	175	Fan Powered VAV w Elec RH: B,C 8
3	FPB2-2	jim@demosite.com	9/2/2010 13:20	Titus FLS Fan Powered VAV w Elec RH: B,C 12	179	Fan Powered VAV w Elec RH: B,C 12
4	FPB2-3	jim@demosite.com	9/2/2010 13:20	Titus FLS Fan Powered VAV w Elec RH: B,C 12	185	Fan Powered VAV w Elec RH: B,C 12
5	FPB2-4	jim@demosite.com	9/2/2010 13:20	Titus FLS Fan Powered VAV w Elec RH: B,C 6	221	Fan Powered VAV w Elec RH: B,C 6
6	FPB2-5	jim@demosite.com	9/2/2010 13:20	Titus FLS Fan Powered VAV w Elec RH: B,C 12	180	Fan Powered VAV w Elec RH: B,C 12
7	FPB2-6	jim@demosite.com	9/2/2010 13:20	Titus FLS Fan Powered VAV w Elec RH: B,C 12	221	Fan Powered VAV w Elec RH: B,C 12
8	FPB2-7	jim@demosite.com	9/2/2010 13:20	Titus FLS Fan Powered VAV w Elec RH: B,C 8	221	Fan Powered VAV w Elec RH: B,C 8
9	FPB2-8	jim@demosite.com	9/2/2010 13:20	Titus FLS Fan Powered VAV w Elec RH: B,C 8	215	Fan Powered VAV w Elec RH: B,C 8
10	FPB2-9	jim@demosite.com	9/2/2010 13:20	Titus FLS Fan Powered VAV w Elec RH: B,C 10	209	Fan Powered VAV w Elec RH: B,C 10
11	FPB2-10	jim@demosite.com	9/2/2010 13:20	Titus FLS Fan Powered VAV w Elec RH: B,C 6	209	Fan Powered VAV w Elec RH: B,C 6
12	FPB2-12	jim@demosite.com	9/2/2010 13:20	Titus FLS Fan Powered VAV w Elec RH: B,C 10	201	Fan Powered VAV w Elec RH: B,C 10
13	FPB2-13	jim@demosite.com	9/2/2010 13:20	Titus FLS Fan Powered VAV w Elec RH: B,C 10	201	Fan Powered VAV w Elec RH: B,C 10

Instruction | Contact | Facility | Floor | Space | Zone | Type | Component | System | Spare | Resource | Job | Document | Attribute | Coordinate | Connection

- Contact — People and Companies
- Document — All applicable document references
- Assembly — Components having constituent components
- Spare — Onsite and replacement parts
- Resource — Required materials, tools, and training
- Job — PM, Safety, and other job plans
- Connection — Logical connections between components
- Coordinate — Spatial locations in box, line, or point format
- Issue — Other required handover issues
- Impact — Economic, Environmental and Social Impacts at various stages in the life cycle

COBie – Revit Toolkit

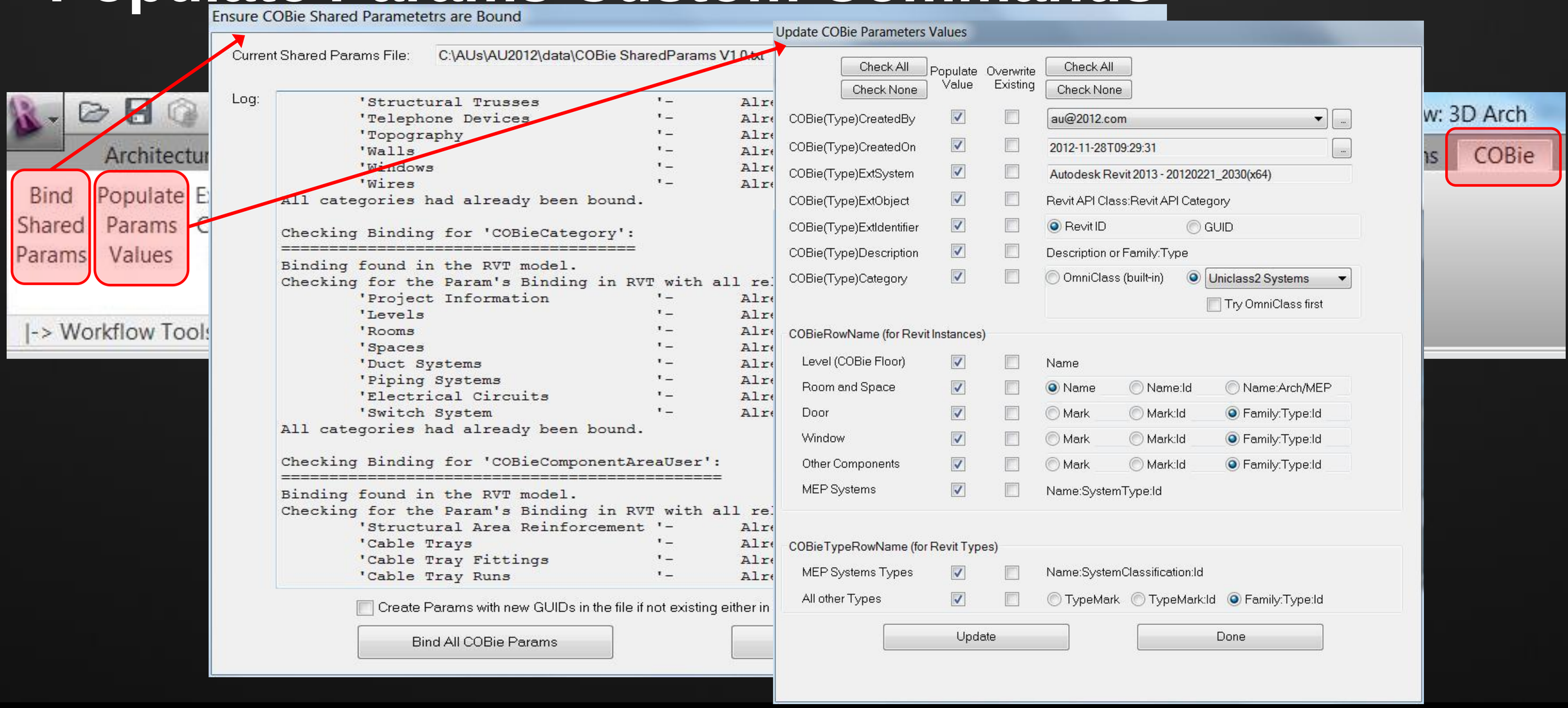
COBie Toolkit for Revit

- The workflow and consequently the custom commands based on 3 steps:

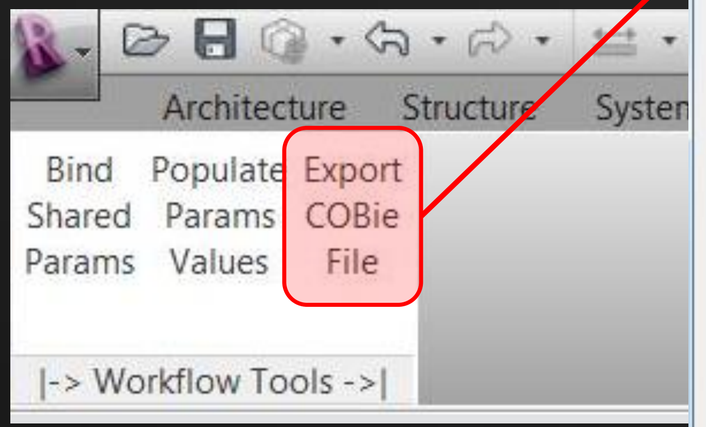
1. Create/Bind specific Shared Parameters used for COBie export
   - Needs to be done just once or not at all if already done in a template
   - Shared Params file provided to make sure GUIDs are unique

     (NOTE: It will work with any GIUDs since identification based on Param Names. There is even an option to create the params in the file. This requires caution if copying elements between models!)
2. Populate these parameters
   - Comprehensive and flexible UI options to populate them from RVT BIM data
   - Can still “manually” edit params if fine-tuning needed before the export
3. Export to COBie XLS(X) file (or optionally to XML)
   - Even more comprehensive and flexible UI options for many aspects
   - Exports data as a combination of directly from BIM model and above params

COBie Toolkit for Revit – Bind Params and Populate Params Custom Commands



COBie Toolkit for Revit – Export Command



COBie Export Options

Excel File:

Template/Initial File: C:\AUs\AU2012\data\COBie-UK-2012-template.xlsx

SaveAs File: C:\AUs\AU2012\data\output\Revit 2013 COBie Test 3.xlsx

XML File (NOTE: This is not so-called COBieLite XML format, but simpler similar format just using the sheets/columns names

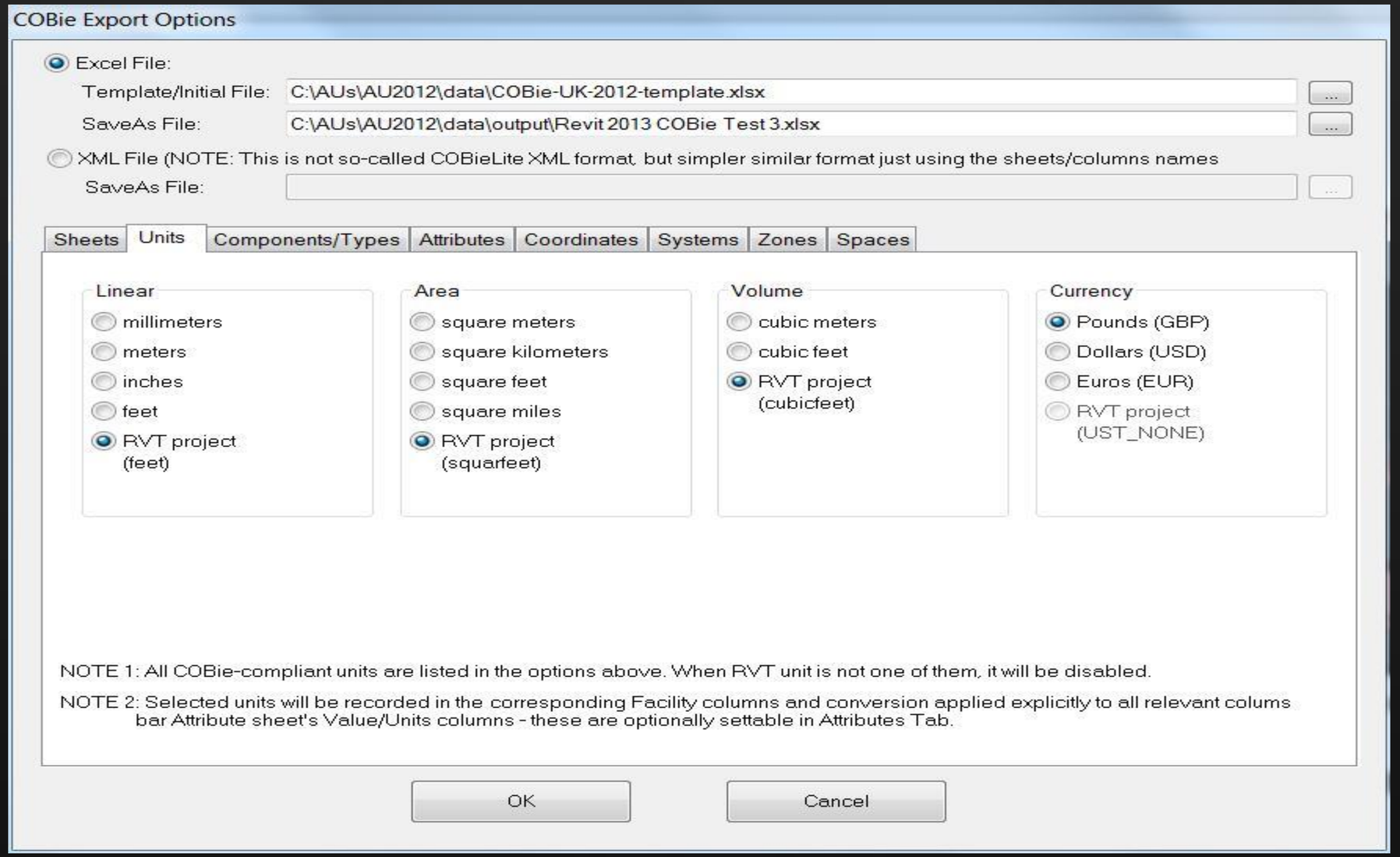
SaveAs File:

Sheets | Units | Components/Types | Attributes | Coordinates | Systems | Zones | Spaces

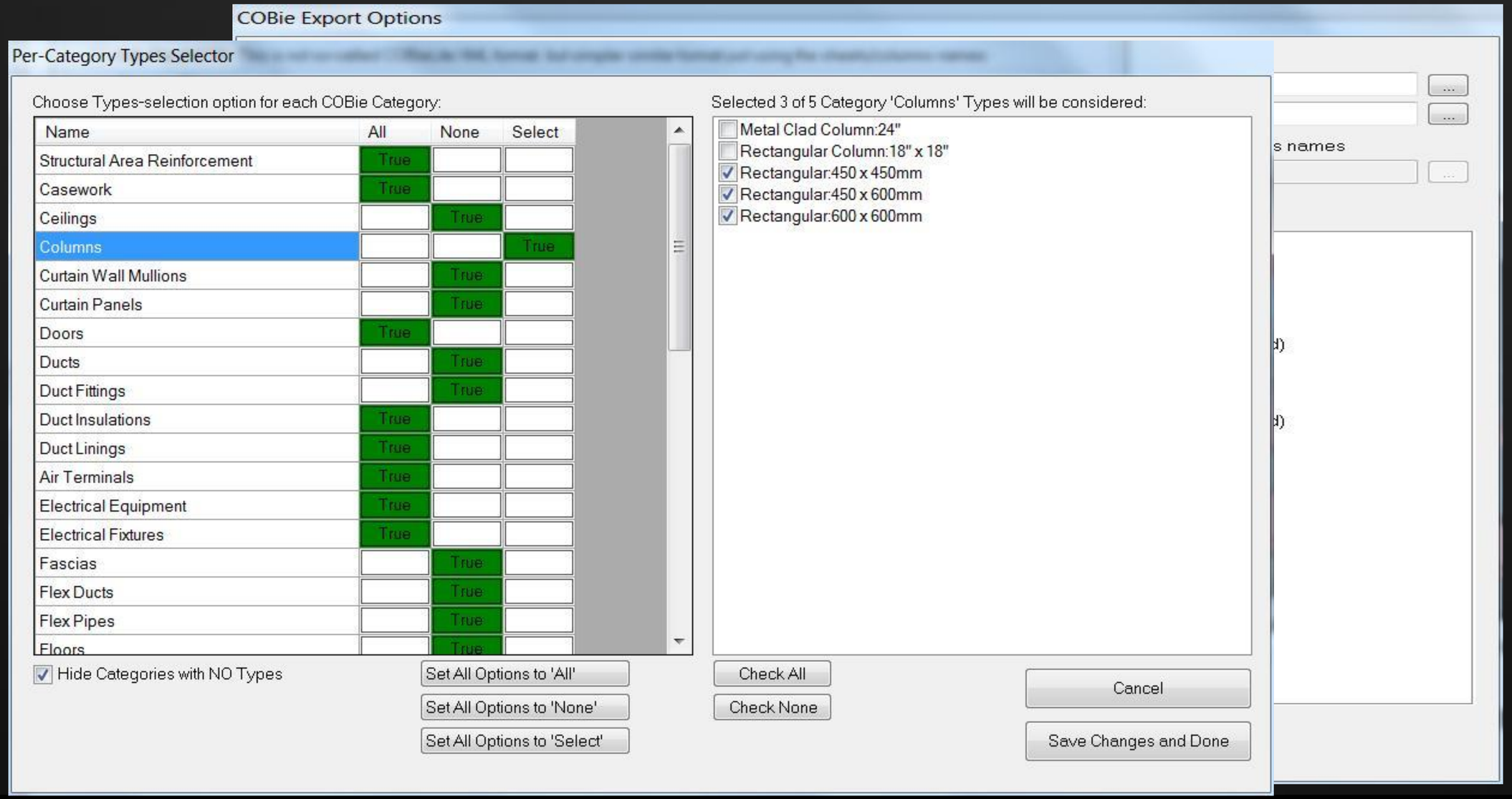
	Select All	Select All	Select All	Check All	Check None
Contact:	Omit	Append to	Overwrite	Clear explicitly beforhand	
Facility:	Omit	Append to	Overwrite	Clear explicitly beforhand	
Floor:	Omit	Append to	Overwrite	Clear explicitly beforhand	
Space:	Omit	Append to	Overwrite	Clear explicitly beforhand	
Zone:	Omit	Append to	Overwrite	Clear explicitly beforhand	
Type:	Omit	Append to	Overwrite	Clear explicitly beforhand	
Component:	Omit	Append to	Overwrite	Clear explicitly beforhand	
System:	Omit	Append to	Overwrite	Clear explicitly beforhand	
Attribute:	Omit	Append to	Overwrite	Clear explicitly beforhand	
Coordinate:	Omit	Append to	Overwrite	Clear explicitly beforhand	

OK Cancel

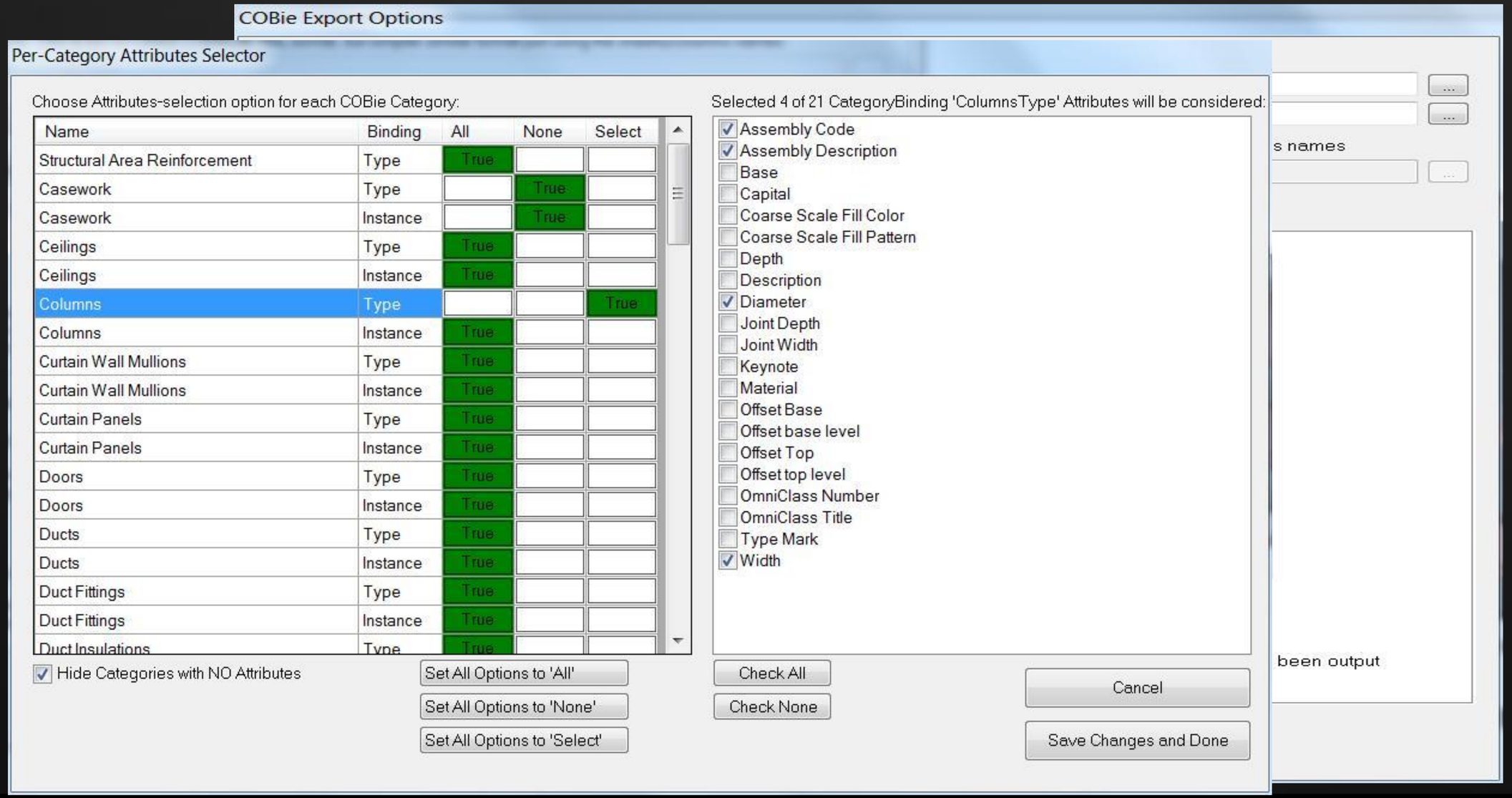
COBie Toolkit for Revit – Export Command Tabs



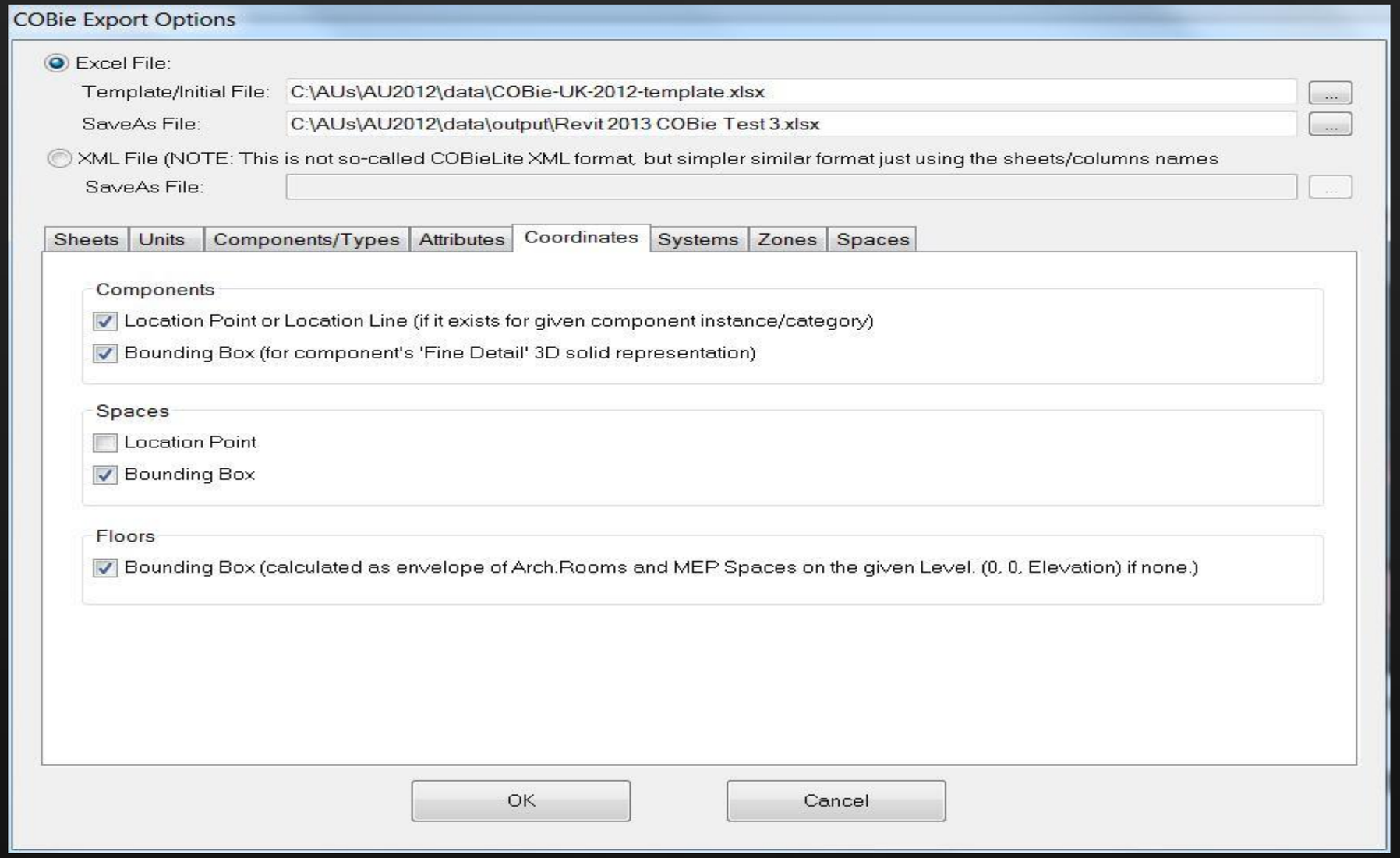
COBie Toolkit for Revit – Export Command Tabs



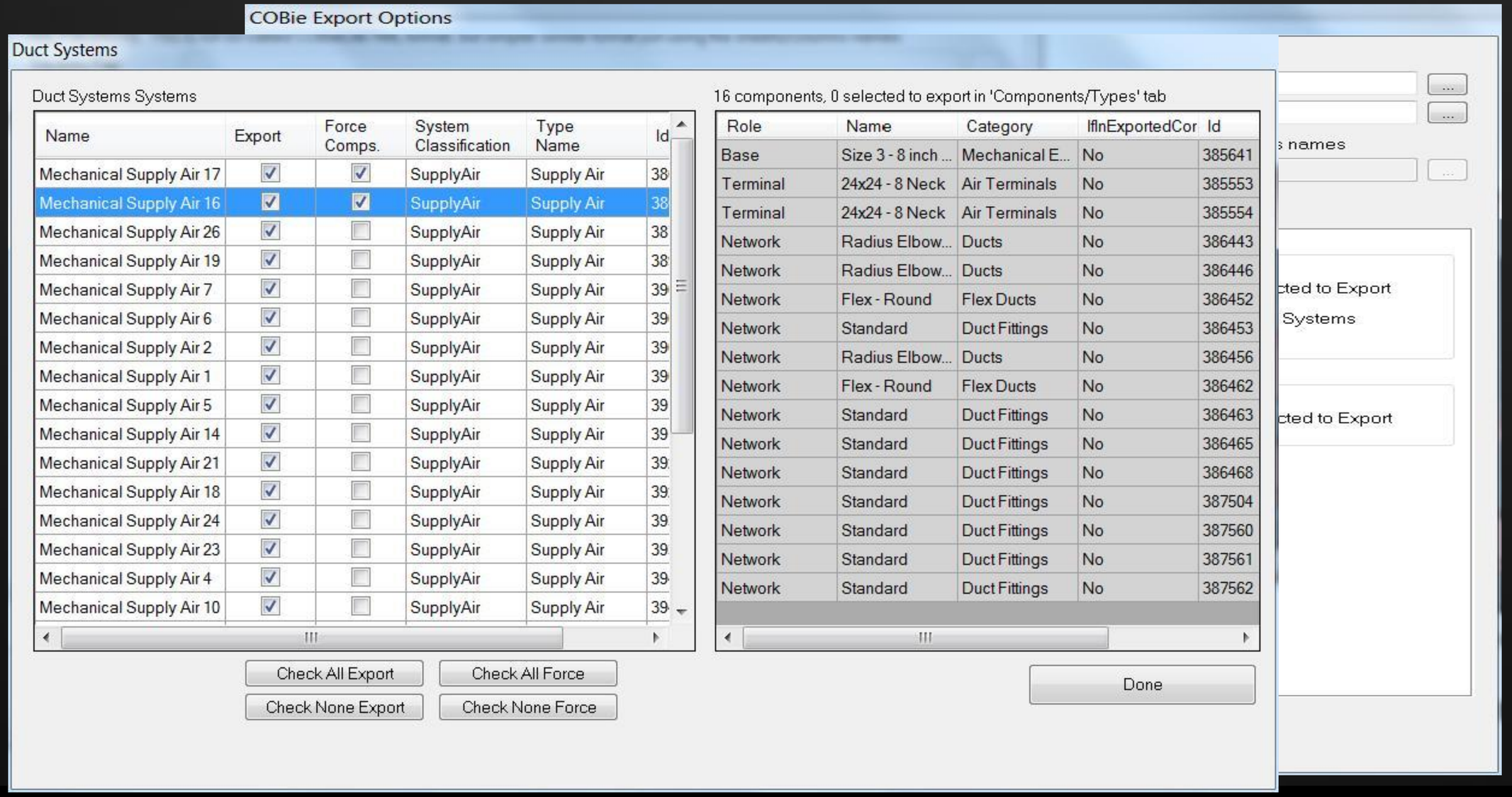
COBie Toolkit for Revit – Export Command Tabs



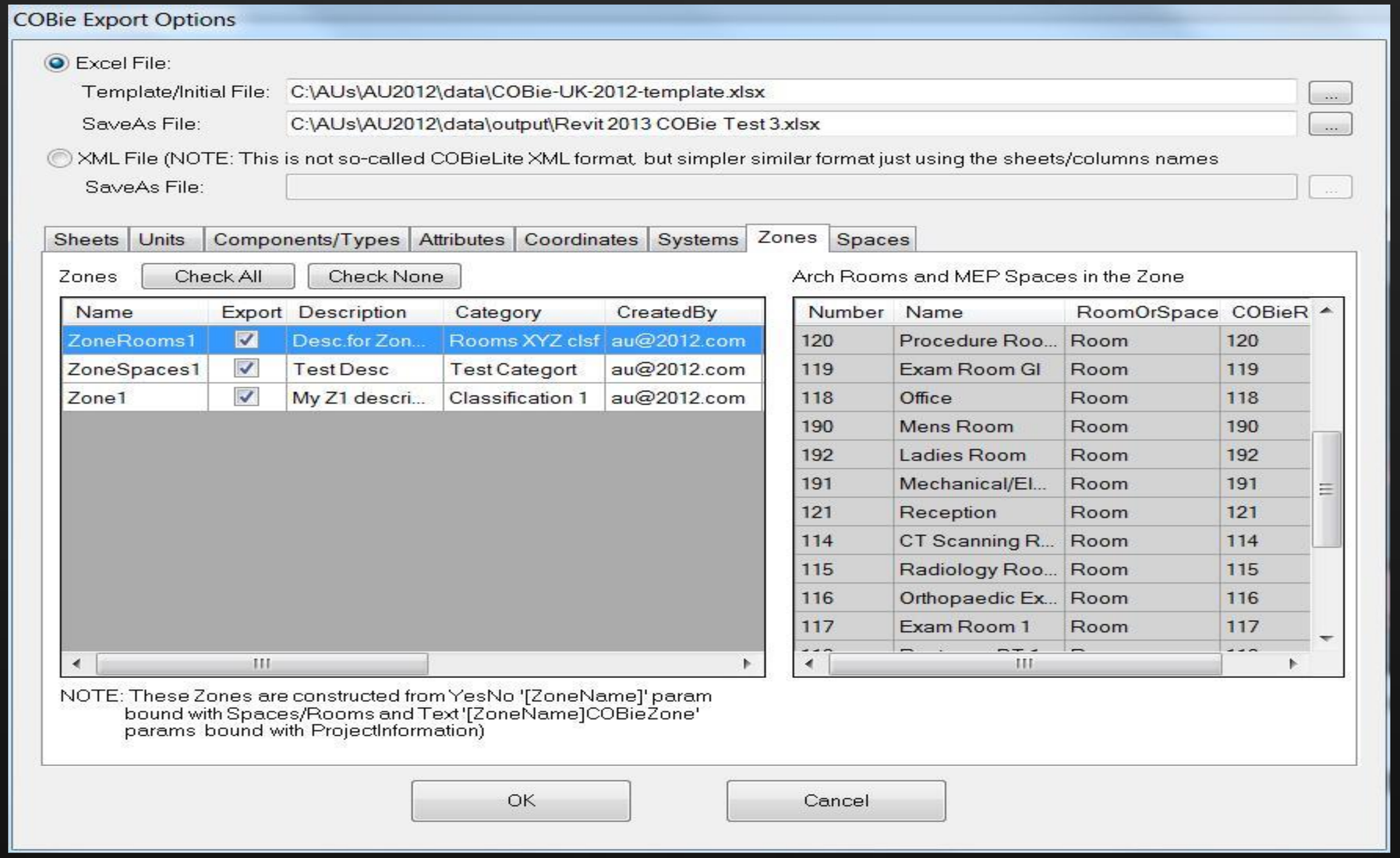
COBie Toolkit for Revit – Export Command Tabs



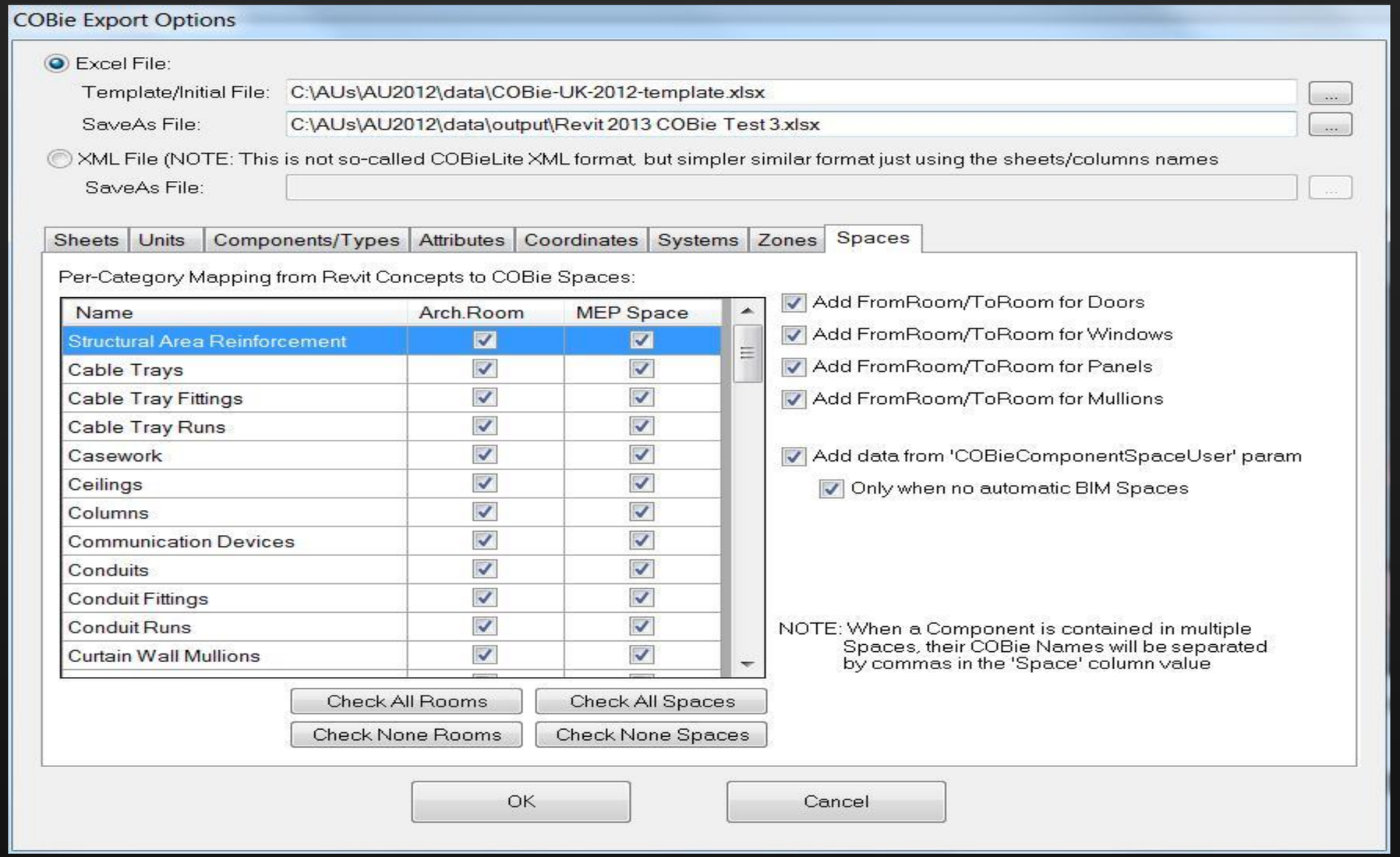
COBie Toolkit for Revit – Export Command Tabs



COBie Toolkit for Revit – Export Command Tabs



COBie Toolkit for Revit – Export Command Tabs



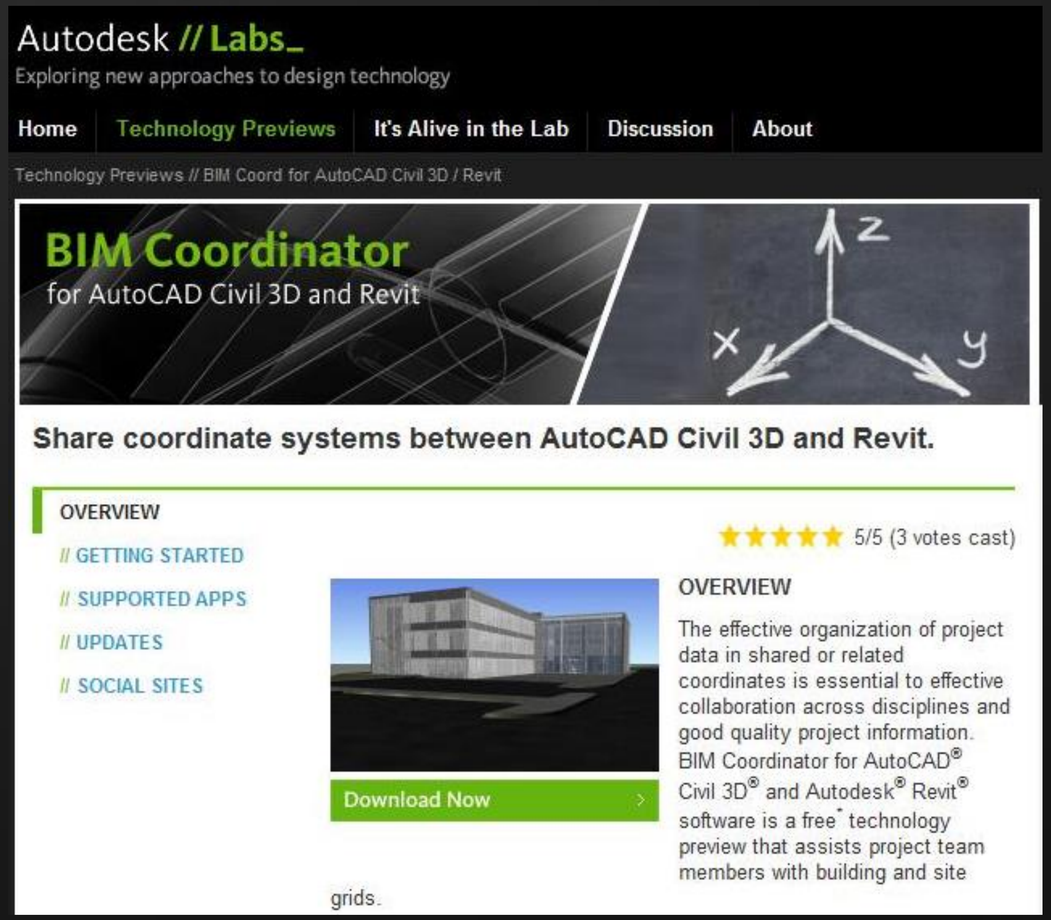
COBie Toolkit for Revit

- Live Demo…

BIM Coordinator

BIM Coordinator - Summary

- Add-on tools for Civil 3D and Revit to facilitate setting Shared Coordinates in Revit based on Civil 3D Locations (Coordinate Systems)
- 2012 version Installs and Docs published to Autodesk Labs: http://labs.autodesk.com/utilities/bim_coordinator/
- 2013 version recently completed (to be published to ADSK Subscriptions)



Coordinate Systems in Revit vs Civil 3D/AutoCAD

- Revit
  - Uses Architectural Terminology/Concepts
  - Shared Coordinates (or “Sites”), Project/True North, XY-plane always horizontal
  - See “Manage” Ribbon Tab -> “Project Location” Ribbon Panel
  - Very good detailed summary in: AU2010 DL316-1, section 5
- Civil 3D/AutoCAD
  - Uses CAD Terminology/Concepts
  - WCS, UCS-es, any XY-plane rotation
  - Various UI elements
- Comparison
  - Basically, both deal with the SAME mathematical/geometrical aspects
  - Confusion based on users being more Revit or AutoCAD – background centric

Problem Assessment

- AC Technical Consultants and Customer Success Managers were consistently reporting customers having problems spatially coordinating RVT models in C3D
- With new C3D 2012 features enabling non-corridor entities being visible in cross-sections, it became very important to import **full Revit 3D DWG** models precisely in C3D models.

NOTE/CAVEATS regarding Revit's **ADSK-format** export to Civil 3D:

- Full **3D DWG export** should be used for the above-described requirements.
- The **ADSK format export** is still the main recommended workflow to get Revit models within Civil 3D, as it's designed to produce more lightweight Revit shell, connection points, textures and BIM information.
- ADSK format does however have some issues with locating the model ☹. Its hard-coded location feature is based on the *survey* point in Revit which shared coordinates do not set, so ADSK format does not get affected/fixed by the current tools.

Problem Assessment

- Initial assessment produced the workflow document for a fully “manual” workflow:

➢ See Revit to Civil 3D Interoperability Workflow - Draft.docx

- The obvious weak points that could be automated are:
  - Manual, error-prone and slow recording of AutoCAD coordinates/angles
  - Manual, error-prone and slow creating of Revit Shared Coordinates, Rotation and Elevation based on the above.

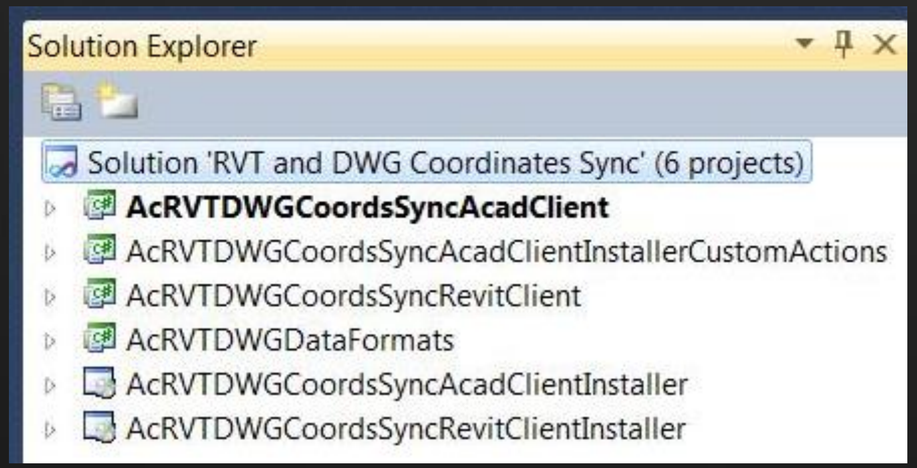
- Hence…an opportunity for AC (or any developer) to design and develop appropriate add-ons based on Revit and AutoCAD/Civil 3D APIs ☺

Solution Design

- The workflow is Civil 3D-cetric, ie civil-site design determines the positions of building(s)
- Civil 3D and Revit users would typically be using different machines, possibly also in different locations.
- Therefore, the logical design was to:
  - Provide Civil3D/AutoCAD add-on to export “locations” into a “neutral” file
  - Provide Revit add-in to automatically create “Sites” (Shared Coordinates) from these neutral files
  - The obvious choice for neutral file is XML

Solution Modules

- There are a few C# projects in the Solution, dealing with specific tasks:

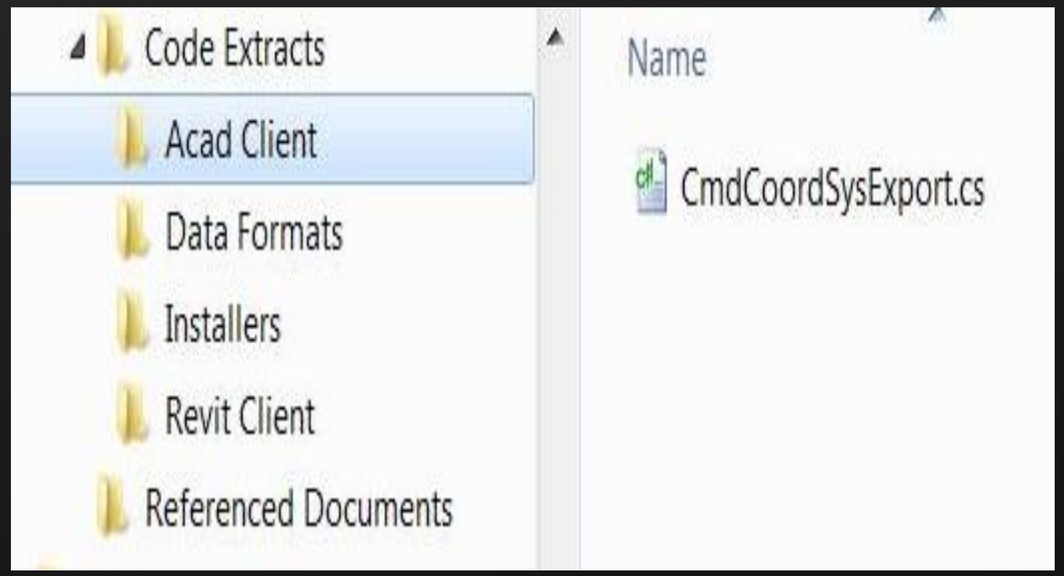


- **DataFormats:** Defines neutral XML file format, independent of any ADSK APIs
- **AcadClient:** References Acad.NET DLLs and DataFormats; provides Acad command
- **RevitClient:** References Revit API DLLs and DataFormats; provides Revit command
- **Acad/Revit ClientInstaller**: provide two separate installers
- **AcadClientInstallerCustomActions**: provide custom step for Acad Installer (see later)

Solution Code

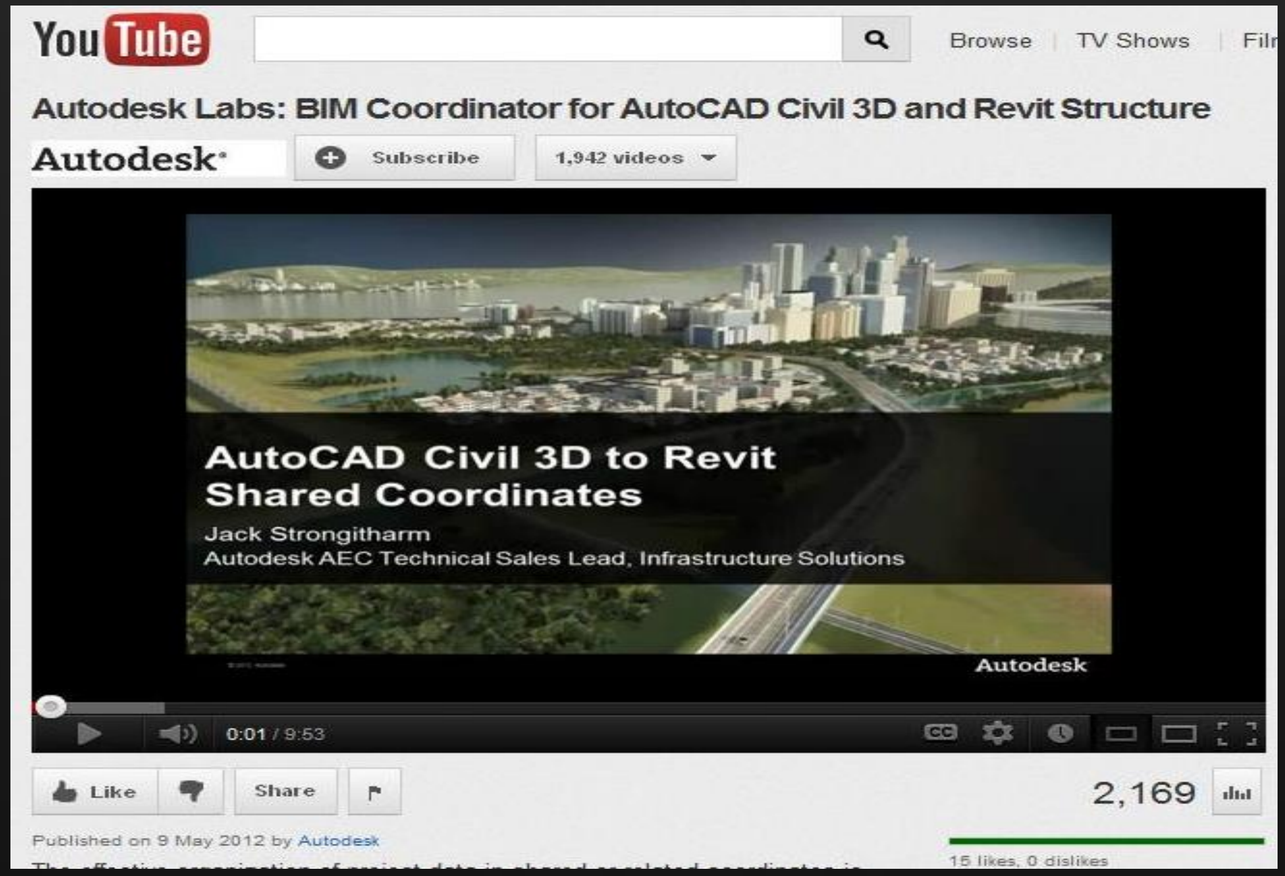
- Solution/projects cannot be provided in the entirety, but most interesting source files are provided in the subfolders:

- See : Data Formats->CoordSysZup.cs
- See : Acad Client->CmdCoordSysExport.cs
- See : Revit Client->CmdACCSXMLImport.cs
- See : Installers->:
  - AcRVTDWGCoordsSync.addin
  - ToolBoxCfg_AC_AcCoordSysExport.xml
  - AcadInstallerHelper.cs



BIM Coordinator – Full Functionality Demo

Accompanying video published to YouTube or available for Download

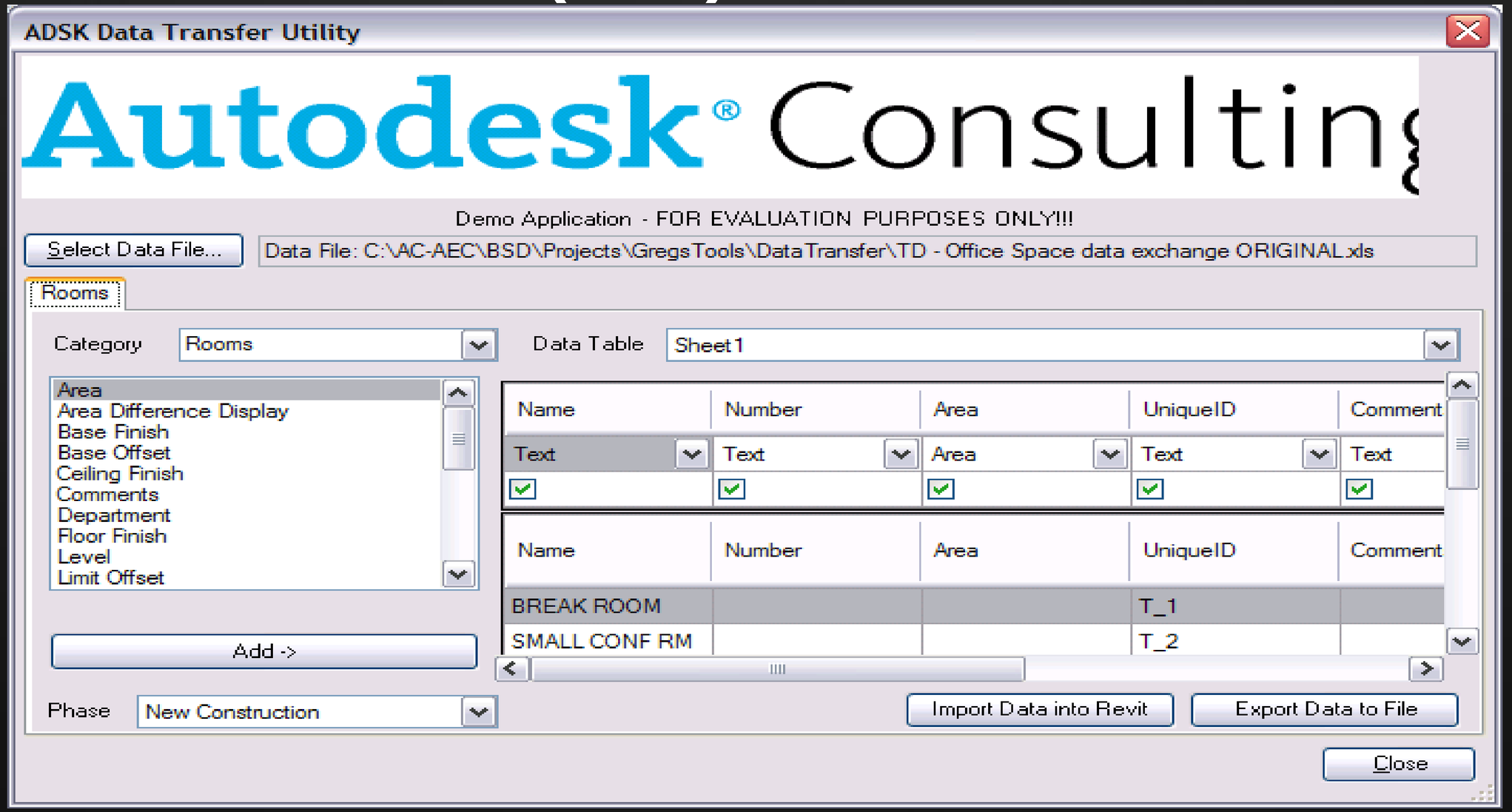


Other BIM Utilities

Data Transfer Tool (DTT)

- Tool that facilitates bi-directional exchange of data between a RVT model Parameters and XLS columns.
  - Also can create unplaced Rooms in RVT
    - (other elements requiring geometry cannot be created)
  - Automatically recognizes new/deleted/existing elements after the last export
    - Identification based on Revit Ids stored in each workbook
  - Automatically creates and binds new shared parameters in Revit if new columns in XLS detected

Data Transfer Tool (DTT)



Data Transfer Tool (DTT)

- Live Demo…