AUTODESK **UNIVERSITY** 2015

BU11642

The Present and Future of Making BIM Useful for Owners

Learning Objectives

- Discover the benefits and potentials of using BIM from an owner's perspective
- Explore the workflows for seamless information exchanges from design and construction to operations and management
- Discover new technologies and processes to enhance information accessibility for OM staff
- Discover opportunities for integrating BIM applications with operations and management applications

• Description

How can we extend Building Information Models' (BIM) values from design and construction to operation and maintenance (O&M)? How can we tackle challenges that data created from design and construction not making it to operations or not meeting the standards? What are the enabling technologies for owners using BIM? If you're interested in finding out more about these questions, this is the class for you. Participants will not only learn about out-of-the-box functionalities of using Autodesk, Inc., products for streamlining building information exchanges, but they will also discover new technologies and opportunities to integrate and customize existing applications within owners' organizations. We will guide you through the workflows and best practices using BIM to define, collect, store, and transfer the valuable information for O&M purposes according to industry standards. You will also see live demonstrations and success stories that highlight the possibilities of capitalizing on BIM for the benefits of facility owners.

• Your AU Experts

Sheryl Yang *is a Building Information Modeling (BIM) expert and advocate with both construction and facilities management background and more than 5 years' experience working on research and implementation of BIM for Architecture, Engineering, and Construction and Facilities Management industry. She is now an Implementation Consultant at Autodesk focusing on providing consulting and training services for the adoption of BIM 360 solutions and BIM practices. Sheryl also helps Autodesk clients integrating BIM 360 platform and data with their existing construction or facilities management applications. Prior to joining Autodesk, Sheryl worked as a researcher and received her Doctoral degree from Carnegie Mellon University (CMU). Her doctoral dissertation focuses on "BIM for Owners", more specifically is to develop new approach using BIM and visualization technologies to streamline facility maintenance workflows. She also taught hands-on labs at CMU for BIM software, including Autodesk Revit and Autodesk Navisworks.*

Benefits and potentials of using BIM from owners' perspectives

Seamless Information Exchange

- Reduce time creating asset inventory from schedule, submittal and specification
- Reduce risk of inaccurate or inconsistent information from manual input
- Complete preventive maintenance program from accurate asset inventory

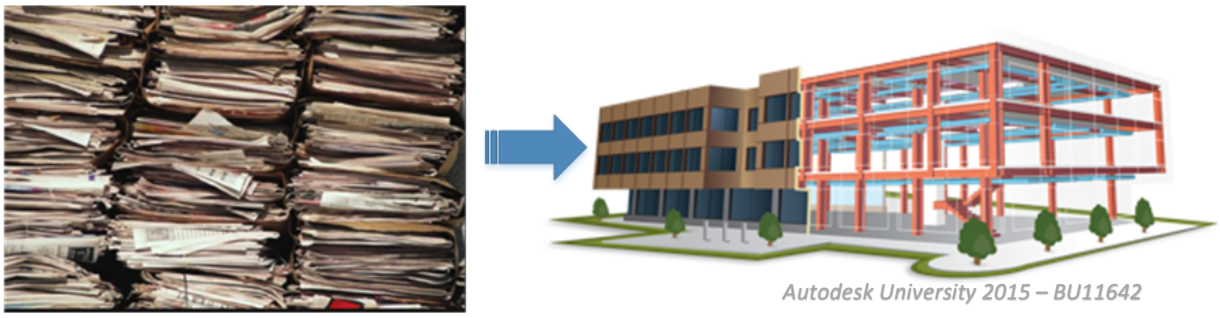


FIGURE 1: TRADITIONAL INFORMATION EXCHANGE AND BIM-BASED INFORMATION EXCHANGE

Information support for efficient O&M activities

- Provide accurate facility equipment and space information before leaving the office
- Reduce time wasted on inaccurate or incomplete information
- Reduce cost of repair for building emergencies (such as leaking and electricity outage).
- Mobile access allows anytime, anywhere access to necessary information



FIGURE 2: TRADITIONAL WORK ORDER AND BIM-BASED MAINTENANCE INFORMATION

Single source of truth of facility information

- Reduce time on looking for information from various sources
- Reduce inconsistency among different information sources
- Capture operation and maintenance history to enable better communication of work plan and better equipment selection
- Reduce costs of surveying as-is facility condition for renovation projects

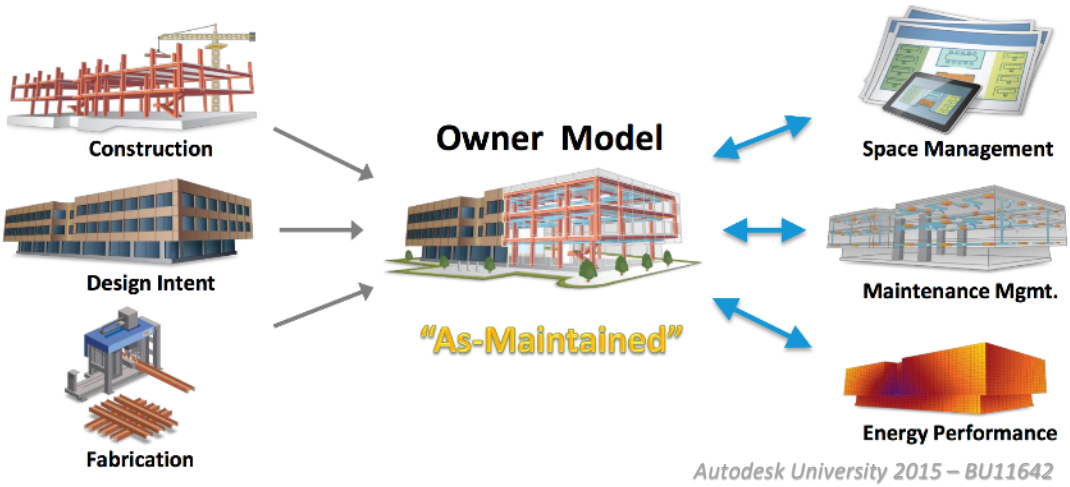


FIGURE 3: SINGLE SOURCE OF TRUTH OF OWNER MODEL

Many of these benefits are discussed in GSA's BIM Guide for Facility Management, please read more at: http://www.gsa.gov/portal/content/122555

Technologies to enhance information exchange and accessibility

Define BIM deliverable information requirements

Understand information handover requirements

The first step essentially is to determine the types of equipment (assets) and the associated properties that the owner is asking or would need. As an owner, simply asking for BIM but not knowing what should include in the BIM cannot make a successful BIM project. Many public facility owner organizations, such as General Service Administration (GSA), US Army Corps of Engineers (USACE), Veterans Affairs (VA) and many university facility management services, now have their BIM guidelines or execution plans to document and specify their requirements:

GSA BIM Guide: http://www.gsa.gov/portal/content/105075
USACE BIM Guide: https://cadbim.usace.army.mil/BIM
VA BIM Guide: http://www.cfm.va.gov/til/bim/BIMguide/lifecycle.htm
Penn State BIM Execution Plan: http://bim.psu.edu

These are great resources for owners who just start developing their own requirements. If the owner does not clearly specify their handover requirements, it may require the GC to have conversations with their owners to understand what they need.

Best Practice: Owners specify handover requirements and model specifications in BIM Execution Plan.

Configure BIM 360 Field Equipment

BIM 360 Field Equipment module is basically an intelligent asset inventory database, which allows you to customize types of equipment and their properties to track. Once owner's handover requirements are defined, this step is just to configure BIM 360 Field Equipment to add the necessary containers for equipment types and standard/custom properties. The type of "equipment" can be any physical building objects you would like to track, whether be VAV boxes, steel columns, precast footings, or windows. Additionally, it is also important to agree on which set of data will be provided by the design team and which set of data is expected to fill out by contractors or subcontractors in construction process. BIM 360 Field has mobile iPad app, which is really easy for field users to enter data on the job site.

Best practice: Configure BIM 360 Field Equipment per handover requirements and define responsibilities of entering data.

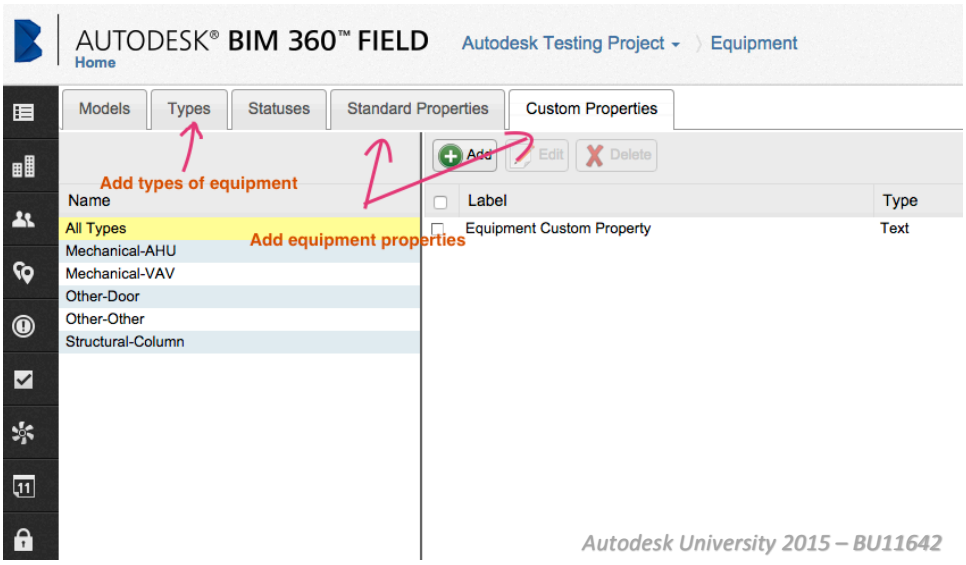


FIGURE 4: CONFIGURE BIM 360 FIELD EQUIPMENT MODULE

Populate equipment inventory and property mapping

BIM 360 Field allows you to create equipment inventory by manual data entry, excel file import, or model import. Using coordinated model to populate equipment inventory is the most automated and efficient method. Each defined model element will become an equipment record in Field and the design parameters can be selected to import as equipment properties. These videos demonstrate how to import a model from BIM 360 Glue and create equipment

records in BIM 360 Field:

BIM 360 Glue/Field Integration: Part 1 - Creating Equipment Sets:
https://www.youtube.com/watch?v=lvJwq7n0v78
BIM 360 Glue/Field Integration: Part 2 - Mapping Properties:
https://www.youtube.com/watch?v=peIGc89uFa4

The technical process is not a challenge when the coordinated models have good component classifications and rich properties. However, I found many times at this step the GCs realized the problem that their models are lacking properties and need to ask their subcontractors to add the properties to the source models, and this may become the roadblock of completing the workflow when this was happening towards the end of the project and subcontractors' modeling work was already considered done at that point. For example, ideally each piece of equipment should have an asset identifier, such as AHU-101, and VAV-300. The identifier should in human-readable format which can be used for cross-referencing, searching, sorting, and filtering in equipment inventory. If the model components do not contain the assent identifier, the resulting equipment records will not be in a readily consumable format. Revit models are typically easier to use than AutoCAD models because the former is a more information-rich modeling tool.

Best practice: Consider downstream BIM uses for equipment inventory and state upfront on necessary model metadata for contractors or subcontractors' model deliverables.

Understand BIM information deliverable formats

BIM 360 Field is used by many contractors and commissioning agents to collect field data digitally on the job site. This is saving time and improving accuracy than converting from hand written notes from a piece of paper. At the end of the project, the information captured in BIM 360 Field can be easily imported out in Excel format or pushed to design model in order to constitute a true as-built model. We also have seamless data integration between BIM 360 Field and Revit, or BIM 360 Field and Navsiworks. In addition, a new member in BIM 360 portfolio – Building Ops can directly consume equipment data in Field and be ready to use for O&M activities on Day One after handover. The final deliverable format will again depends on owner's handover requirement. Is the owner asking for a model? If it's a model, is it in native Revit format, or published Navsiworks NWD format? Is COBie a requirement? Does the owner have CMMS in place?

Deliverable as Revit file

Revit has a BIM 360 add-in which can directly add BIM 360 Field Equipment properties to current model (as shown in Figure 6. Equipment Properties button).

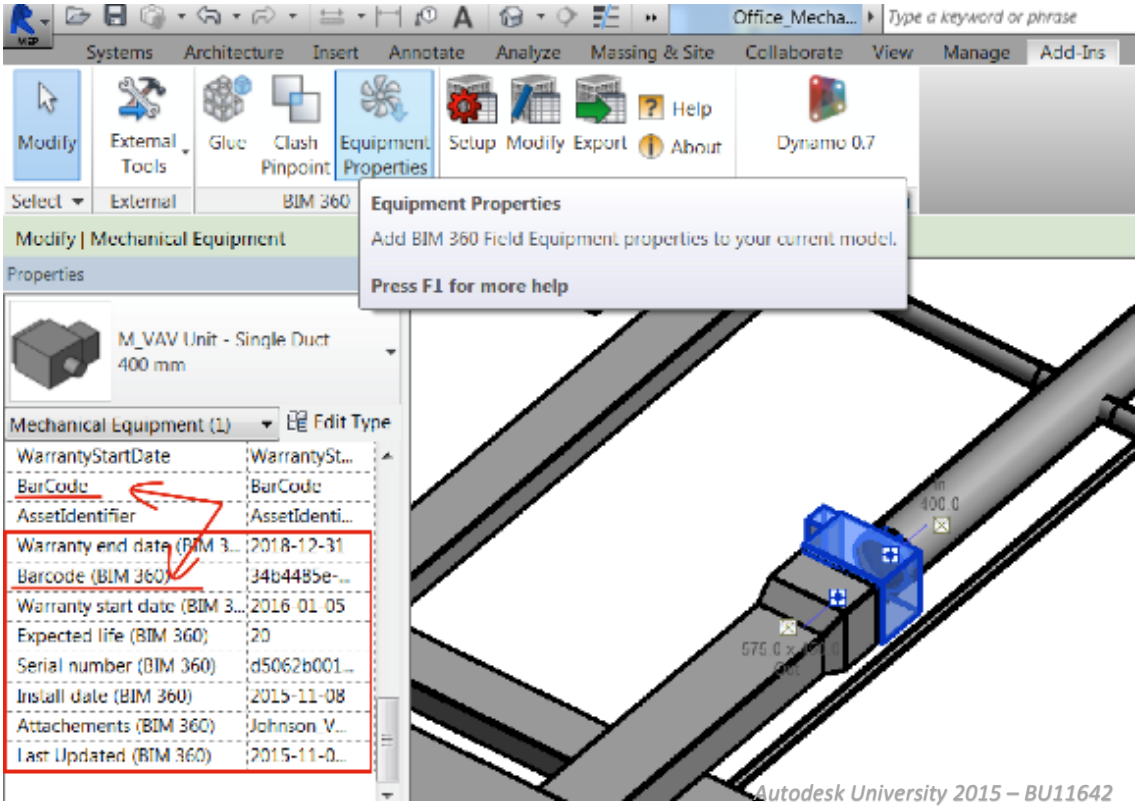


FIGURE 5: DELIVERABLE IN REVIT FORMAT

The new properties will appear as Revit shared parameters and be automatically pulled in against relevant model components. The shared parameters created by BIM 360 Field will have suffix of "(BIM 360)". What's worth mentioning here is that the new BIM 360 shared parameters will be separated from original shared parameters existing in components' properties, even though they have the same name or of the same meaning. For example, Barcode (BIM 360) is a separate parameter from Barcode property and only Barcode (BIM 360) will be populated by the valued captured in BIM 360 Field. This is because shared parameters are recognized by computer using their GUIDs (32-digits combination of random numbers and letters), and BIM 360 parameters are linked with the new shared parameter in Revit by GUID. It is possible to map these BIM 360 parameters to existing shared parameters and will be explained later.

Deliverable as Navsiworks file

The properties of equipment records in Field will become available in Navisworks under a "BIM 360" tab in the property window. The Navisworks model is typically saved as a NWD file as deliverable to the owners. The equipment properties can also be exported out in Excel format using Selection Inspector.

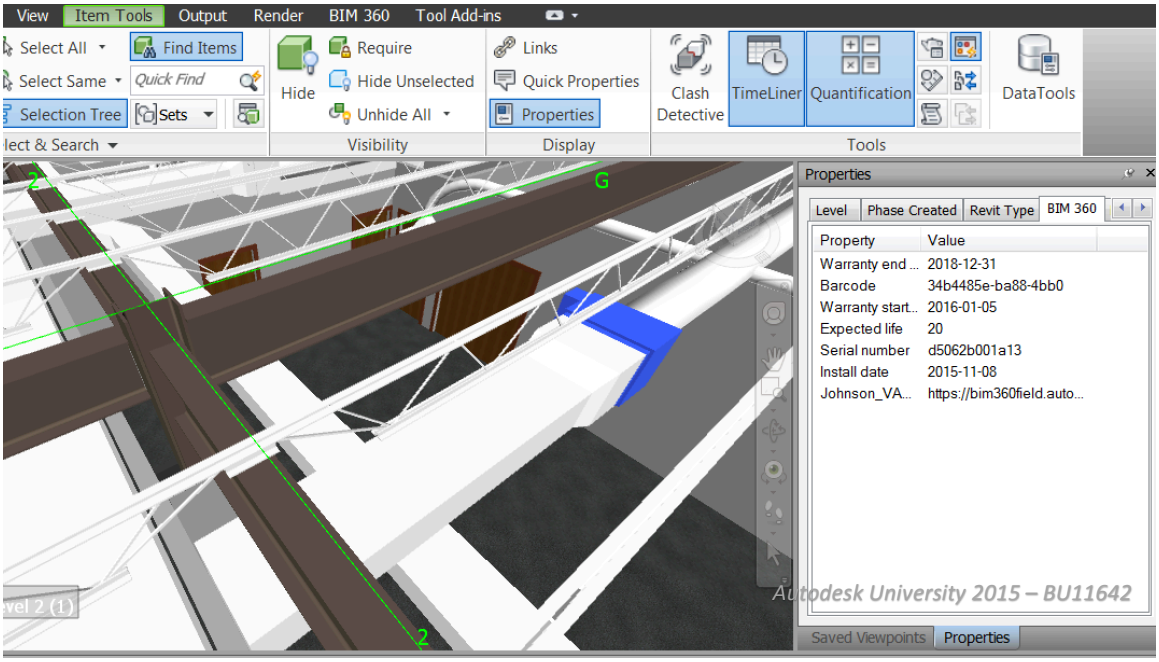


FIGURE 6: DELIVERABLE IN NAVSIWORKS FORMAT

Deliverable as ready-to-use asset inventory in Building Ops

Autodesk Building Ops is a mobile-first maintenance and asset management solution that helps owners realize the operating potential of their buildings. Building Ops helps improve the handover experience, placing operations data collected during design and construction in the hands of the team maintaining the building on day one. Equipment data collected during design and construction phase can be seamlessly imported to Building Ops.

Select Export to Building Ops from BIM 360 Field Equipment web portal and enter a unique code generated by Building Ops:

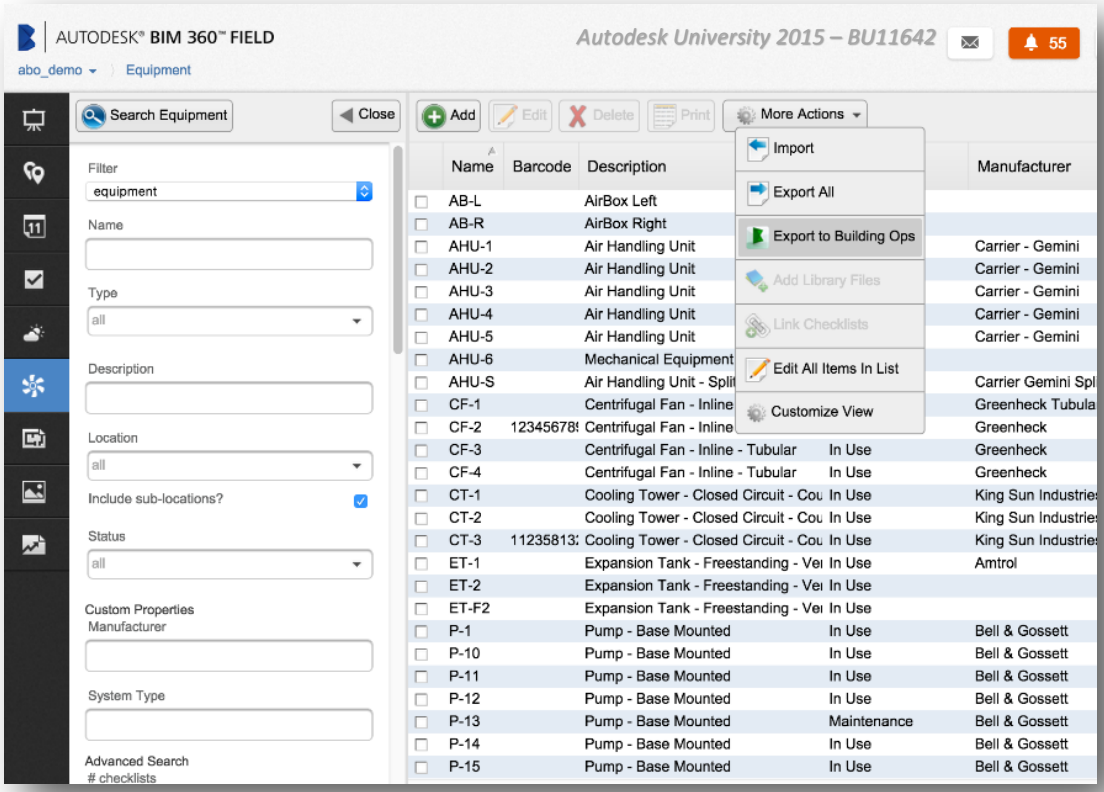


FIGURE 7: EXPORT TO BUILDING OPS FROM BIM 360 FIELD

The list of equipment records in BIM 360 Field will appear in Building Ops Assets module:

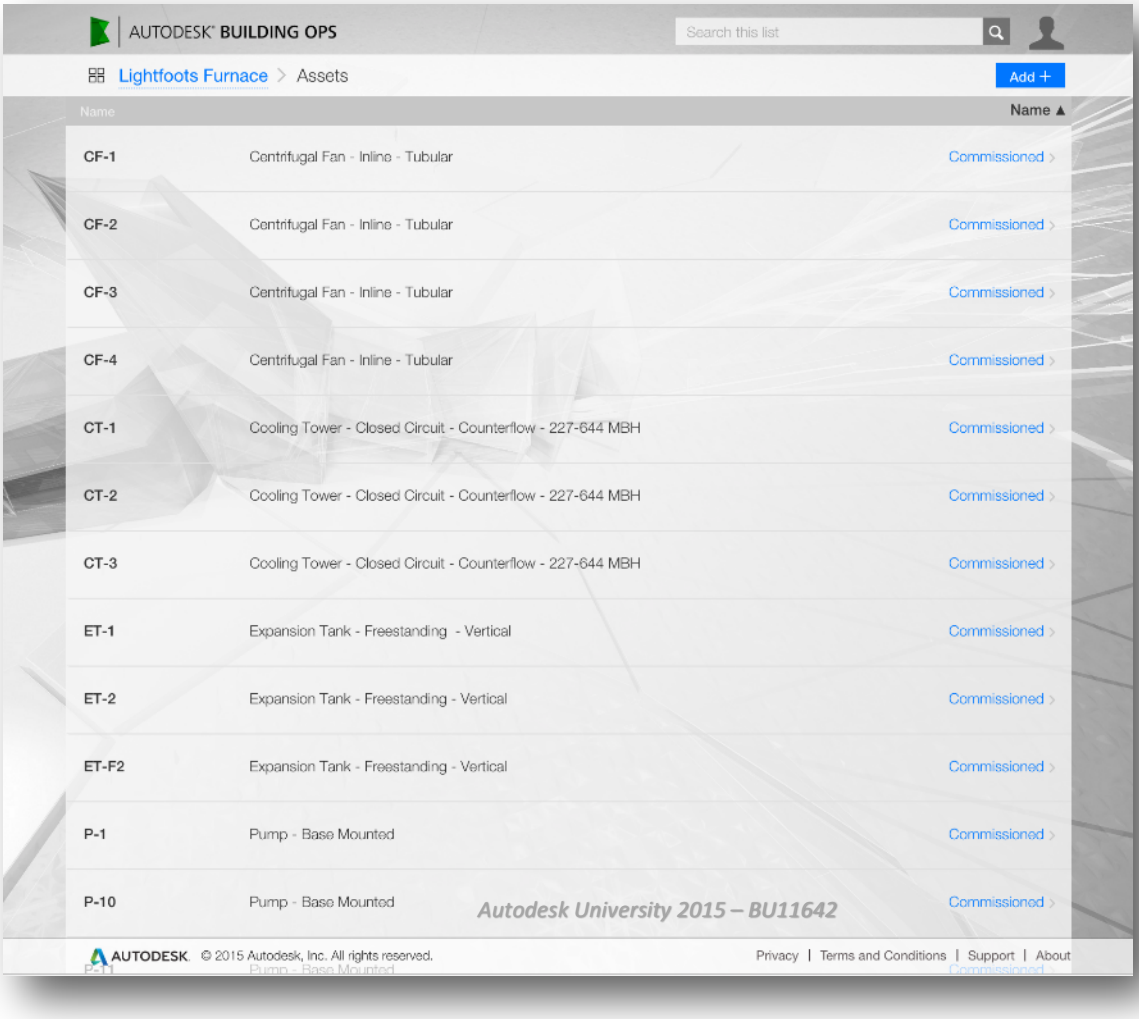


FIGURE 8: ASSET LIST IN BUILDING OPS

Open up an equipment/asset detailed record, you will find many of the asset properties are already populated from data in BIM 360 Field, such as Barcode, Model Number, Install Date, Warranty Expiration Date, and also models, photos, and documents.

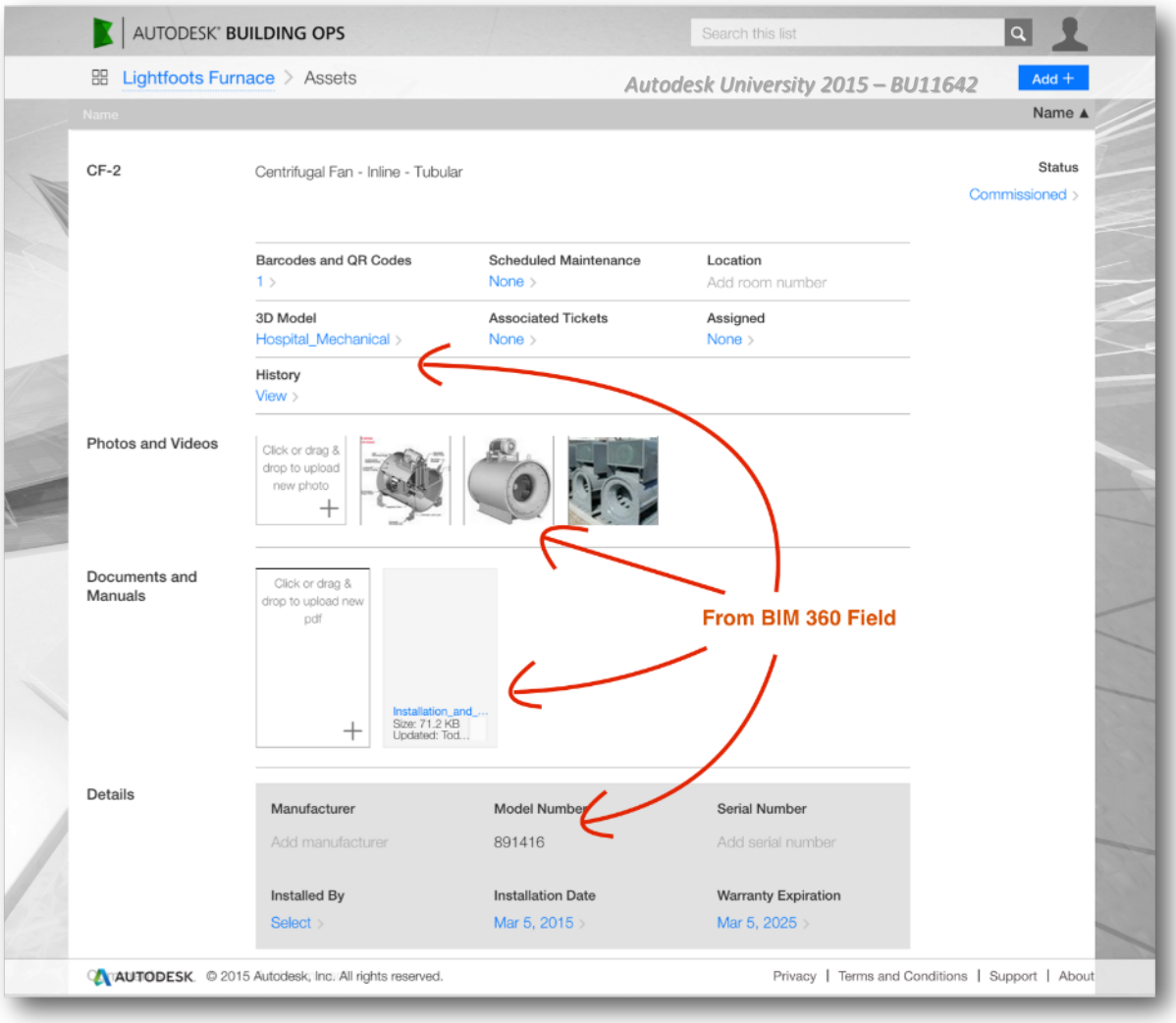


FIGURE 9: ASSET INFORMATION IN BUILDING OPS

Deliverable in COBie format

COBie a standard data format for building information handover and many owners such as GAS require COBie deliverable. COBie simplifies the work required to capture and record project handover data by compiling data during all phases of a project rather than waiting until the end of the project. Autodesk COBie Extension simplifies this process further by allowing you to pull a COBie-compliant spreadsheet directly from your Revit Model (Download free COBie Extension: http://www.autodesk.com/campaigns/interoperability).

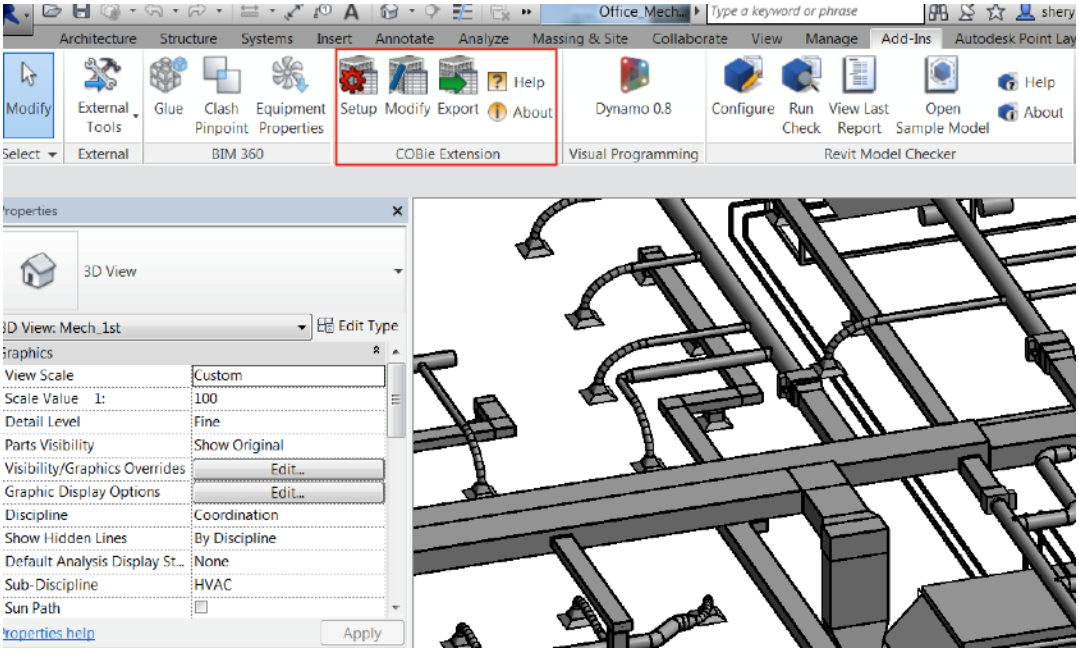


FIGURE 10: COBIE EXTENSION IN REVIT

(1) Configure COBie Extension

A set of configurations need to be defined to customize the COBie export, including contact information, units, spaces, component attributes, components to export, etc. You can find an overview and step-by-step demonstration of how to use COBie extension in this video: https://www.youtube.com/watch?v=0s1zriE3y20

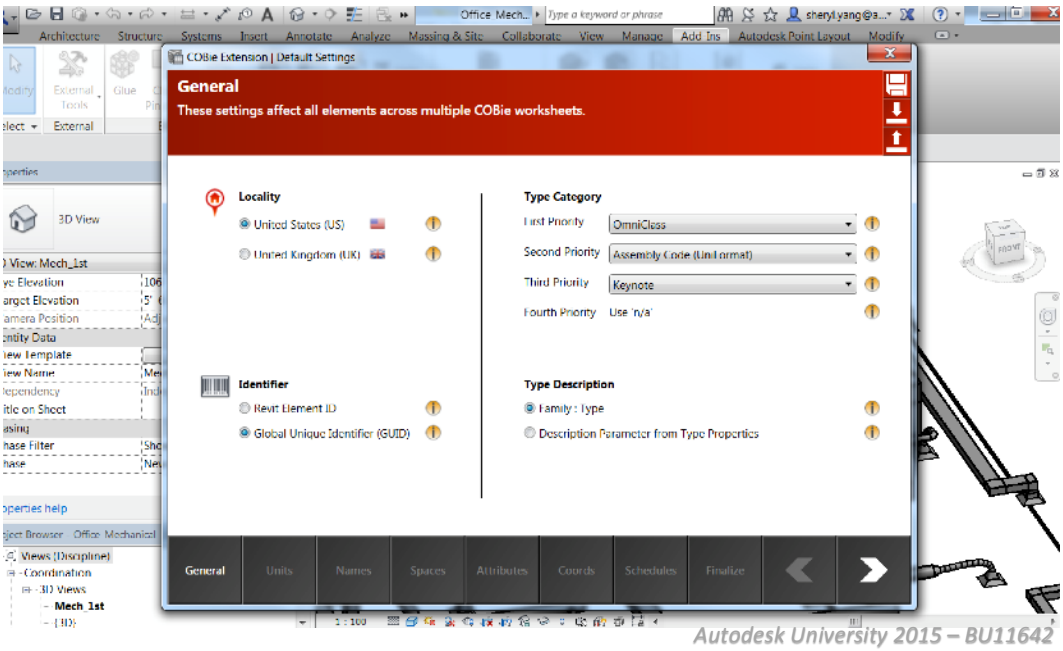


FIGURE 11: COBIE EXTENSION SETUP IN REVIT

After setting up COBie Extension configuration, you will find COBie-compatible parameters are added to Revit model elements:

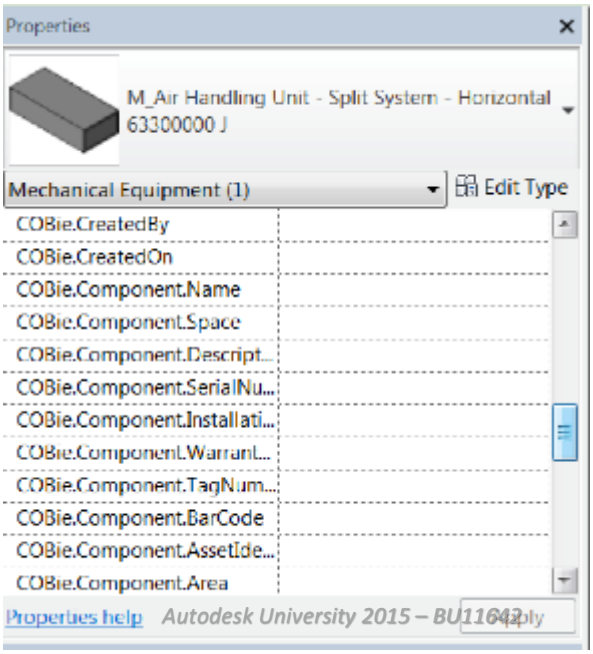


FIGURE 12: COBIE PARAMETERS IN REVIT

Some of these parameters can be automatically filled out by COBie Extension, such as

CreatedBy, CreatedOn, component Name and Space, and other parameters are expected to be filled out by design teams or contractors.

(2) Map BIM 360 Field data to COBie parameter

Notice that many of BIM 360 Field equipment parameters are already COBie-standard parameters – Description, Serial Number, Install Date, Warranty Start/End Date, and so on. If this data is already captured throughout the design and construction process within BIM 360 Field, you can just use the BIM 360 Equipment Properties feature to pull the data in to Revit. Now the question is – how to map the BIM 360 parameters' values to COBie parameters:

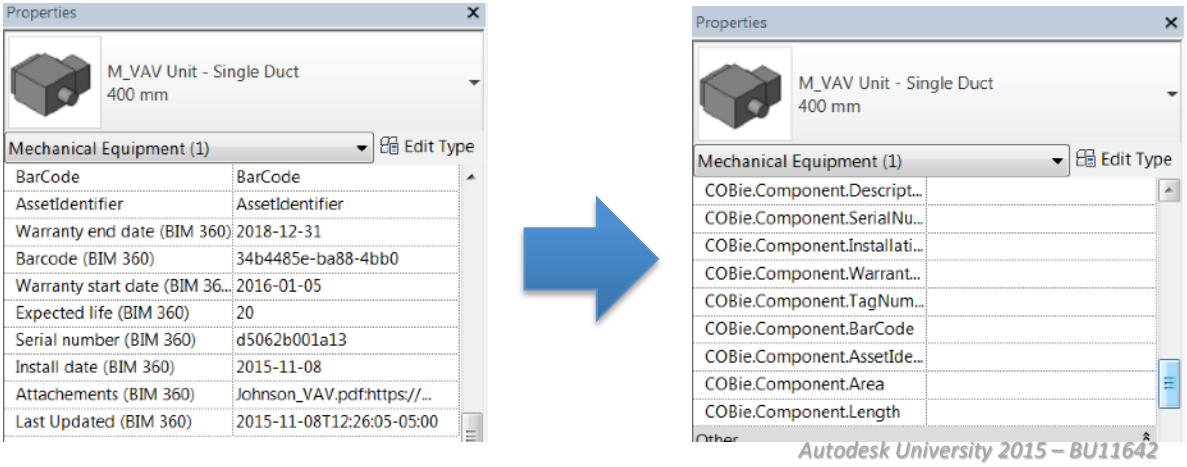


FIGURE 13: MAP BIM 360 PARAMETERS TO COBIE TO PARAMETERS

Dynamo can help automating the parameter mapping process. Dynamo is an open source and visual programming tool that allows extension of parametric functionality and automate tasks in Revit. Fortunately you don't have to start from scratch, our colleague has put together a Dynamo script proof of concept which allows you to automatically pull the values from BIM 360 parameters and populate corresponding configured COBie ones. Please read more and download the script from:

BIM 360 Field data to COBie? Dynamo can help (By Lee Mullin)
http://autodesk.typepad.com/bimtoolbox/2015/10/bim-360-field-data-to-cobie-dynamo-can-help.html

Parameter Mapping in Revit with Dynamo (By Dieter Vermeulen)
http://autodesk.typepad.com/bimtoolbox/2015/10/parameter-mapping-in-revit-with-dynamo.html

Dynamo can run as a Revit Add-in:

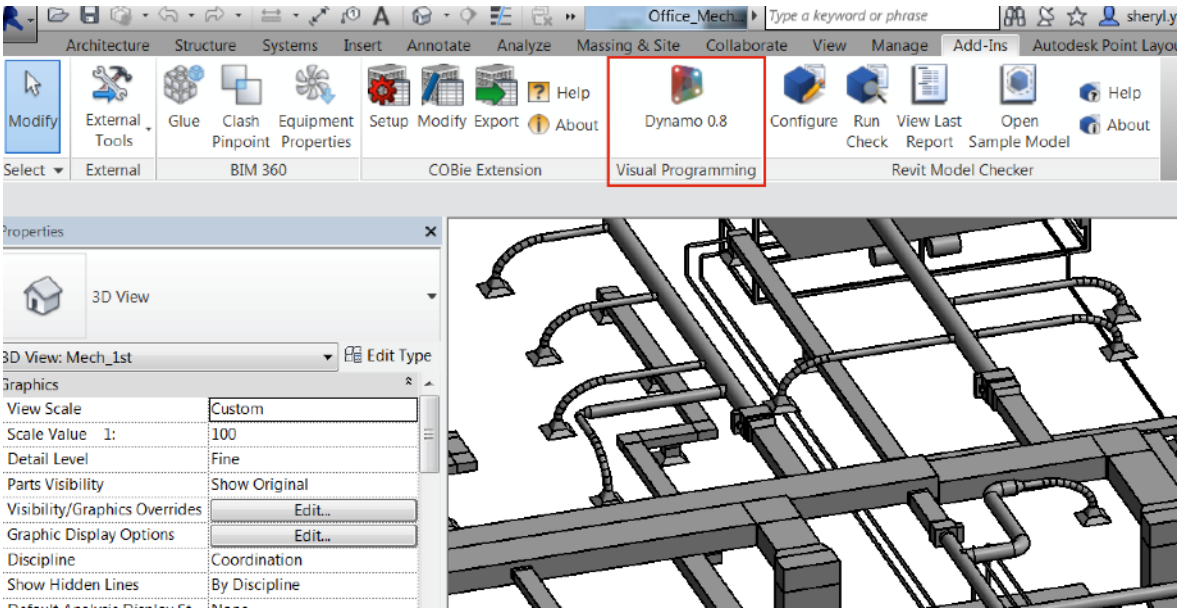


FIGURE 14: DYNAMO AS AN ADD-IN IN REVIT

After running the Dynamo script, now I have the COBie parameter filled out automatically:

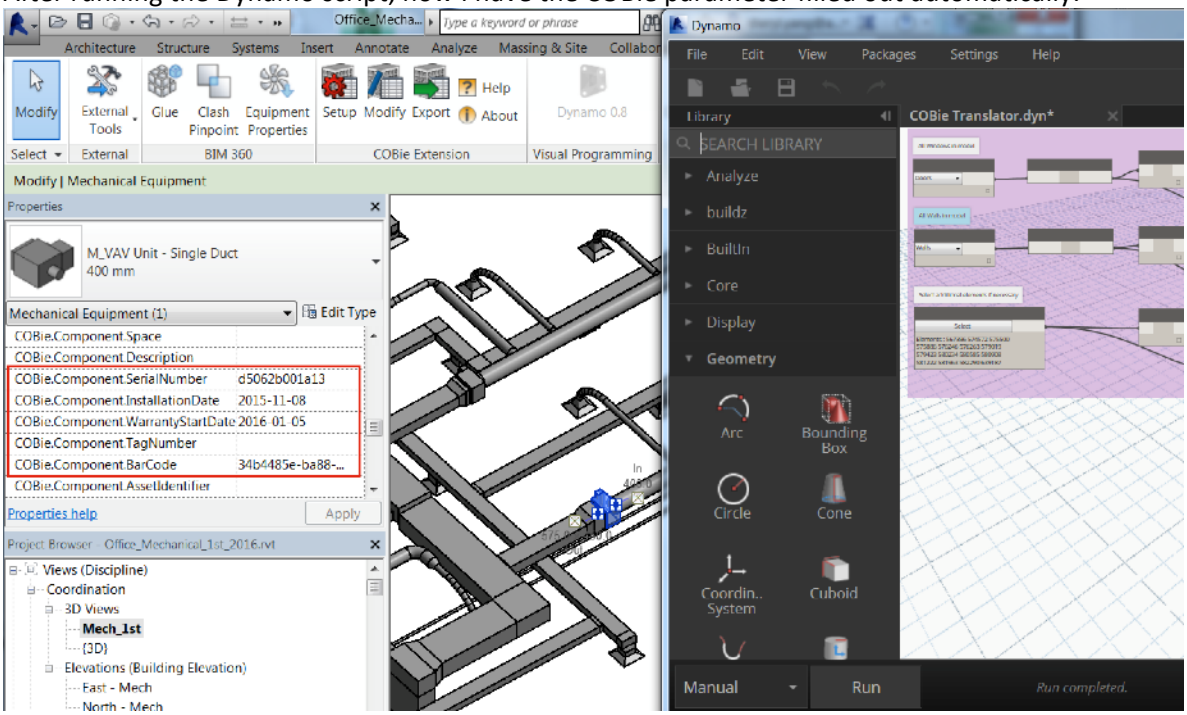


FIGURE 15: DYNAMO SCRIPT OF MAPPING BIM 360 PARAMETERS TO COBIE PARAMETERS

(3) Model Checker for COBie Extension

Now how do you know if your Revit model is COBie-compliant? Do the required parameters exist in the model? Do they contain valid values? Are they properly formatted? Revit Model

Checker can answer these questions and give you a pass/fail report. The Revit Model Checker is an add-in that automatically checks Revit models and helps with verifying compliance to BIM Requirements (read more at http://www.autodesk.com/campaigns/interoperability).

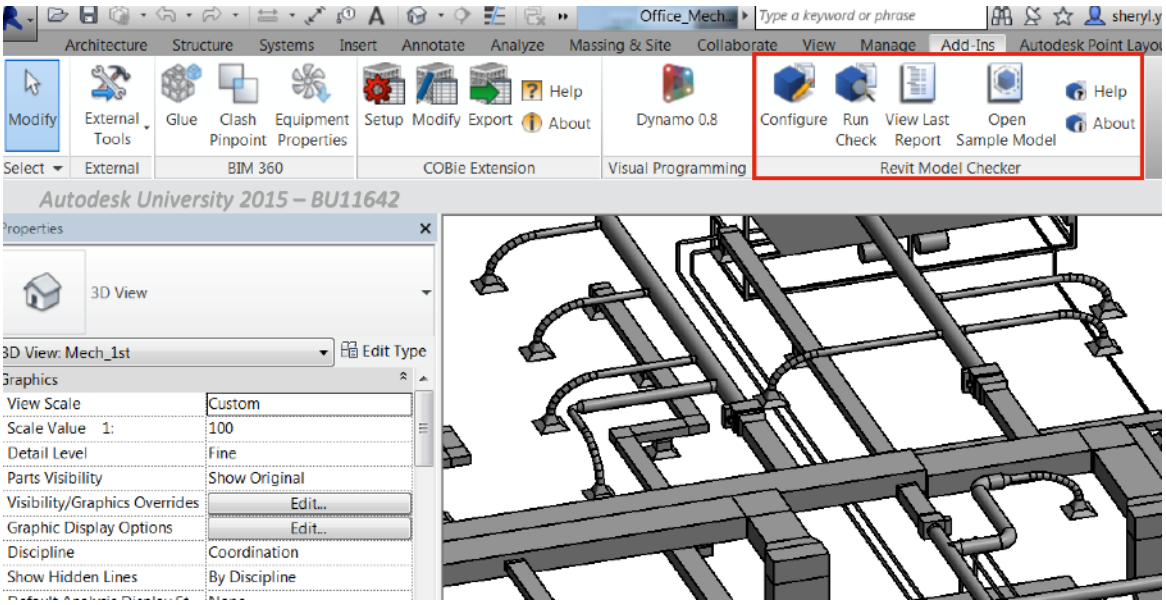


FIGURE 16: REVIT MODEL CHECKER

Revit Model Checker has a built-in COBie Extension template which you can pick and run a report.

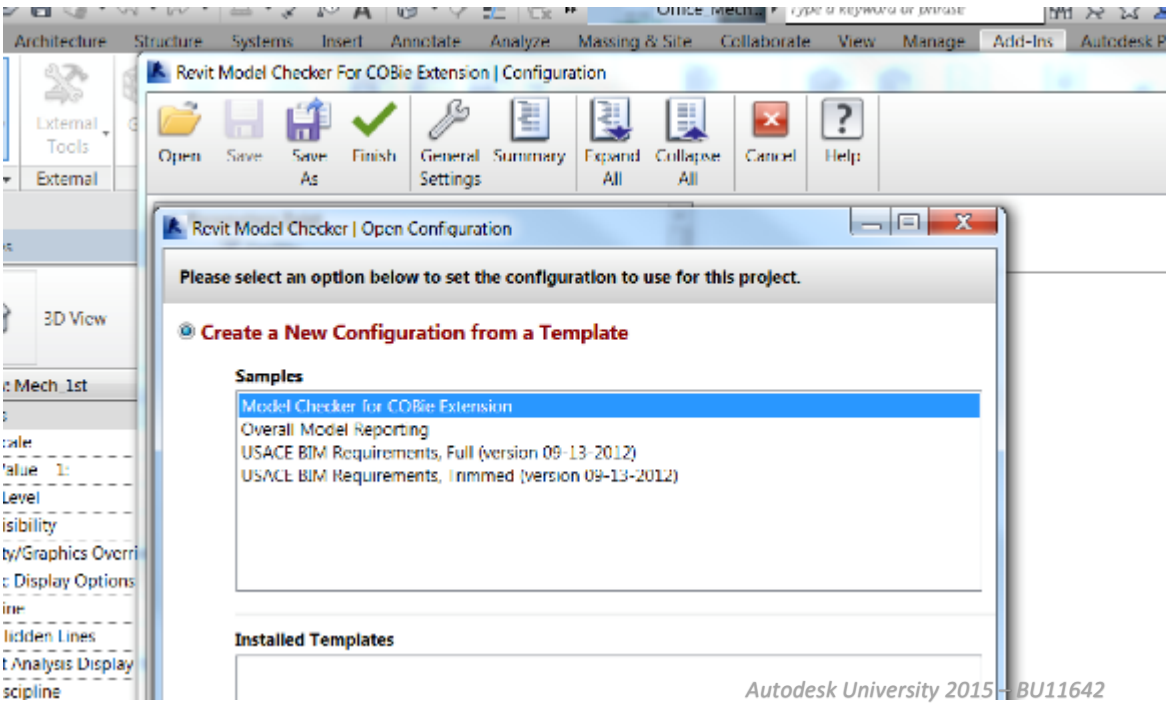


FIGURE 17: REVIT MODEL CHECKER FOR COBIE EXTENSION

Use mobile and owner BIM for facility maintenance

Now we have the required information captured in design and construction, we have a high-quality model as well as the model properties, and the information handed over to facility operation in a consumable format. How do we put the information into the hands of people who need it? It does not help much for maintenance activates when you have a fancy model sitting on a server in an office. Most maintenance technicians will not open up a model in Revit or Navisworks, or even Excel to check asset information. Traditional CMMS also only runs on a desktop computer and technicians only get printed work orders. Maintenance technicians typically have to make multiple trips between jobsite and offices to verify information, or proceed without sufficient and accurate information. NIST study shows that inadequate information costs facility maintenance $6.9 billion in the U.S. capital facilities industry (http://fire.nist.gov/bfrlpubs/build04/PDF/b04022.pdf). We need to provide accessibility to the model and more importantly the information for maintenance technicians. The answer is mobile technology.

Use Building Ops

Autodesk Building Ops is a mobile-first maintenance and asset management solution that helps owners realize the operating potential of their buildings. FIGURE 18 shows four main components of Building Ops: Dashboard, Assets, Contacts and Tickets.

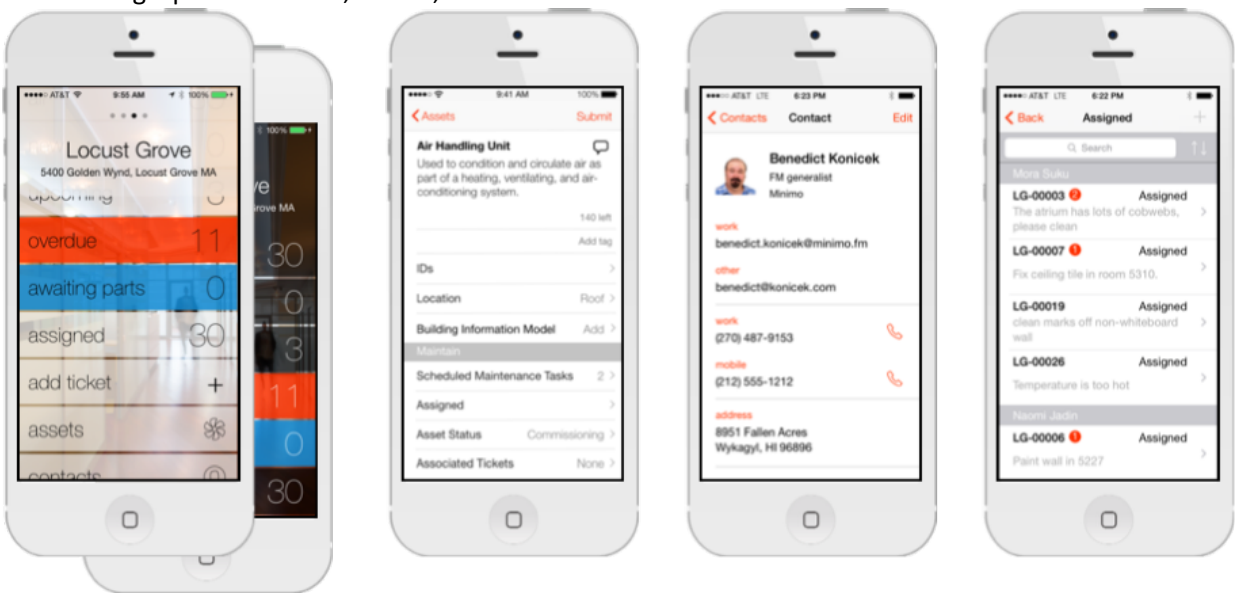


FIGURE 18. OVERVIEW OF BUILDING OPS – DASHBOARD, ASSETS, CONTACTS, AND TICKETS

After building assets are added in Building Ops, facility managers can assign technicians to maintenance tasks and schedule preventive maintenance. Unlike in traditional practice that technicians would receive paper-based printed work orders, Building Ops sends tickets directly to technician's iPhone. The ticket contains much more information than traditional work orders, including asset properties, documents, photos, 3D model, checklists and maintenance history.

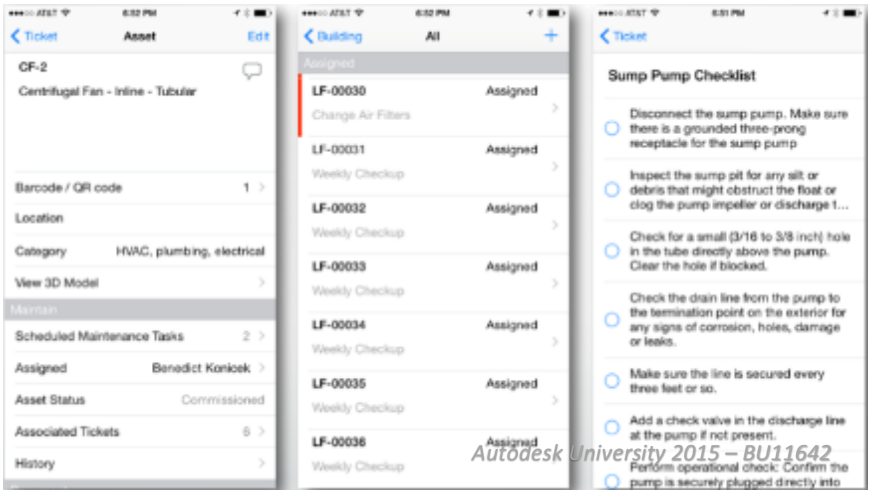


FIGURE 19: A PREVENTIVE MAINTENANCE TICKET FOR AN ASSET AND ASSOCIATED CHECKLIST

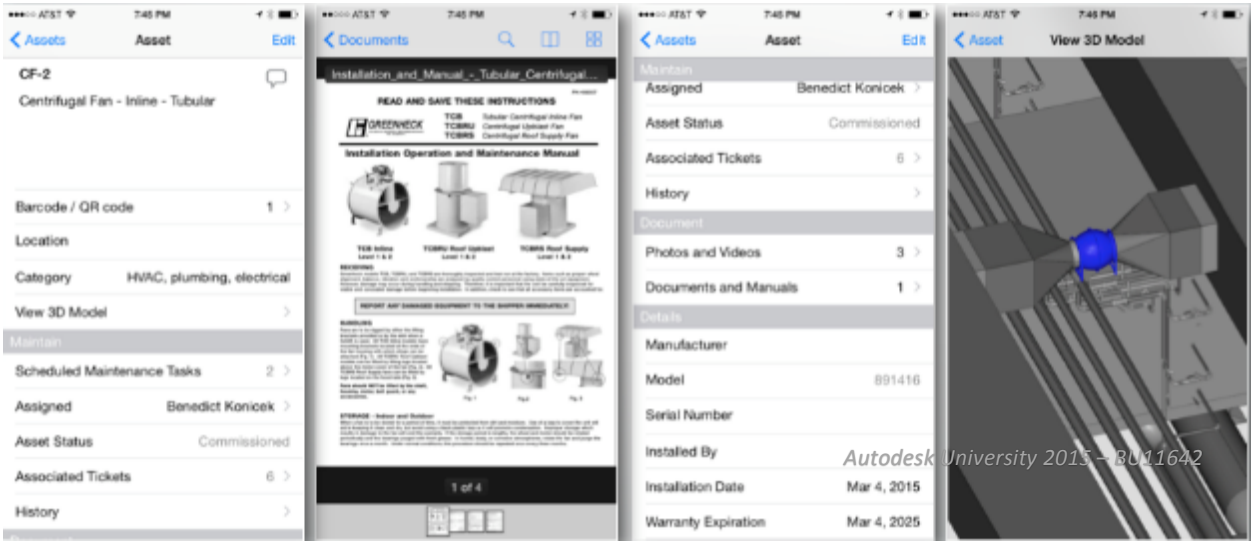


FIGURE 20: DETAILED ASSET INFORMATION

Building occupants can also use Building Ops to request maintenance work, snap a photo and provide comments:

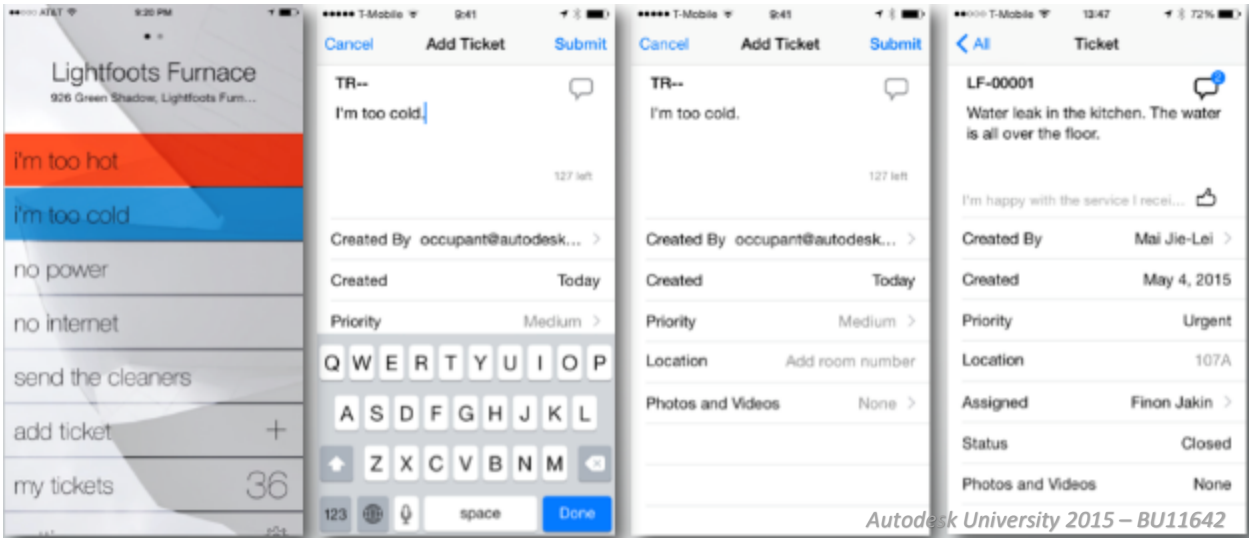


FIGURE 21: OCCUPANT'S USER INTERFACE IN BUILDING OPS

Building Ops user interfaces are designed in a way that it changes based on user's roles. Building managers, technicians and building occupants are exposed to different interfaces with different access to information and functionalities which best fit with their roles. For example, only building managers can review real time reports showing the status of service tickets in all their buildings:

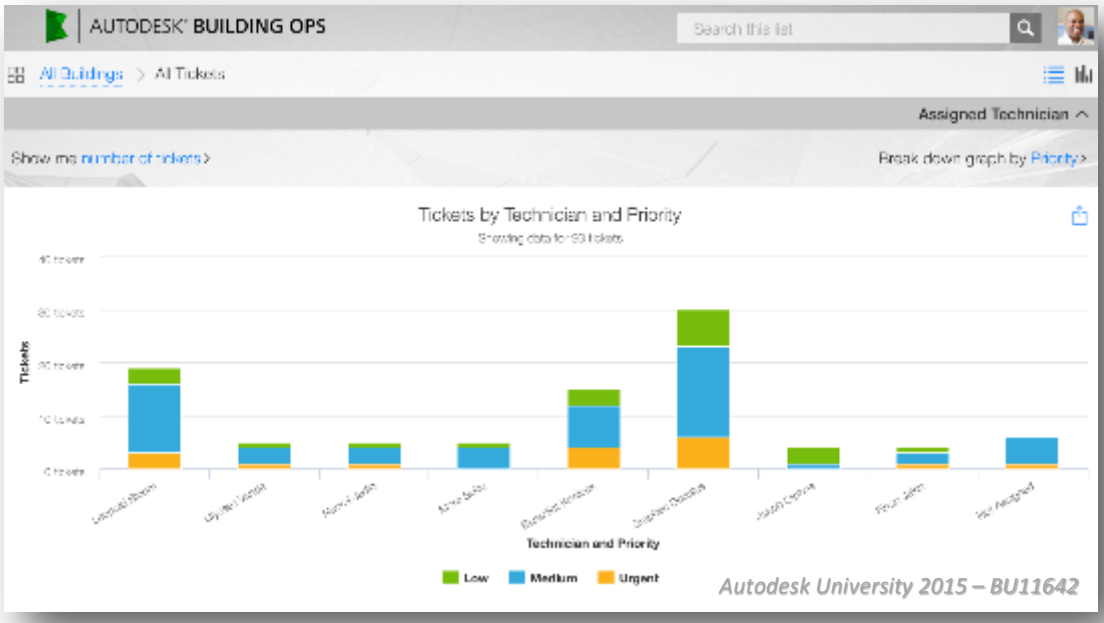


FIGURE 22: REPORTS IN BUILDING OPS

Opportunities for integrating BIM applications with O&M applications

Model Viewer Integration

Autodesk' new generation of model viewer and its API (View and Data API: https://developer.autodesk.com/api/view-and-data-api/) allows you to create custom web based applications and enable your team to visualize and interact with the model as well as the metadata in a web browser or on a mobile device. This new technology and platform opens up existing opportunities for integrating building models with facilities operation and maintenance applications, and bringing visualization and facility data together. Facility management solution leaders Archibus and FM:Systems are already using View and Data API to integrate large building models in their solutions. Find more at:

How I Use Autodesk View & Data API: Archibus

https://www.youtube.com/watch?v=M_usLBL5c0Y

"All of these easily visualized building information; side by side with things like vacancies, preventive maintenance information, documents, warranties, life-cycle costing… It's all in one place."

----- Steve Segarra, CTO of Archibus

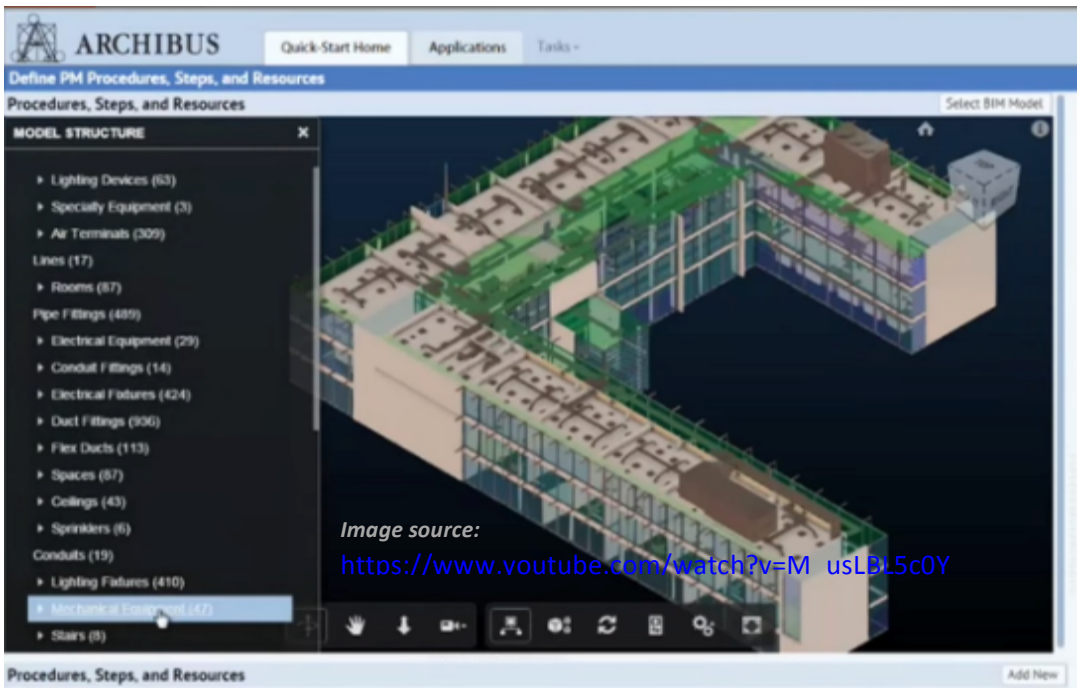


FIGURE 23: VIEW AND DATA INTEGRATED WITH ARCHIBUS

How I Use Autodesk View & Data API: FM Systems

https://www.youtube.com/watch?v=T3OxhznSKqs

"Maintenance technicians out there in the field can interact with facility data, and can actually be updating the model live."

----- Brian Haines, Director of Marketing at FM:Systems

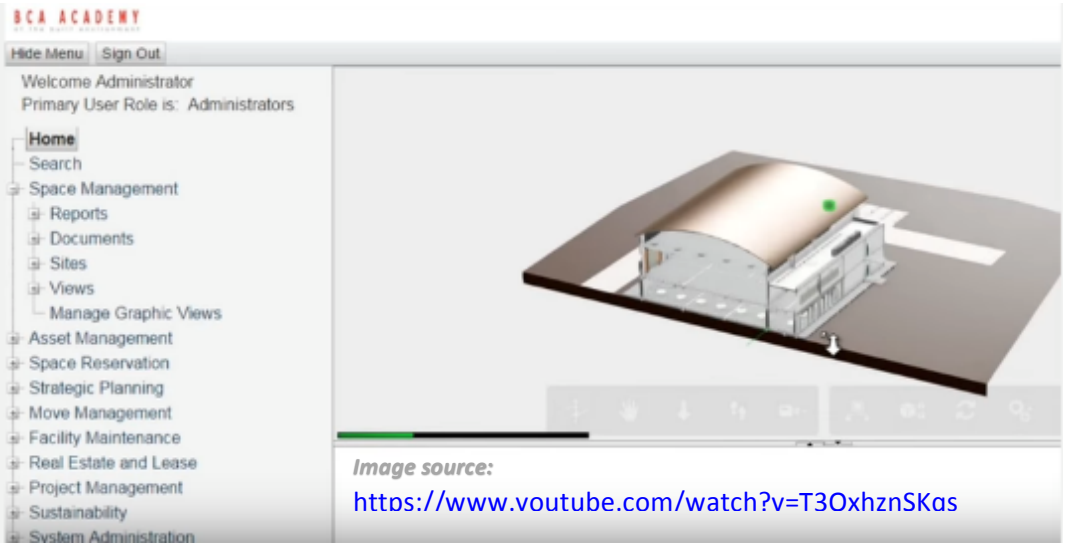


FIGURE 24: VIEW AND DATA INTEGRATED WITH FM:SYSTEMS

Maximo Extensions for BIM

Another leading CMMS application IBM Maximo has also integrated with Autodesk BIM solution (Navisworks). "This includes support for importing/updating BIM data, export from Maximo, and full 3D display of BIM data in context with Maximo applications and processes. The data import implements a subset of the COBie standard" (Read more: http://www-304.ibm.com/software/brandcatalog/ismlibrary/details?catalog.label=1TW10MA44#tab-overview). An example of the solution is:

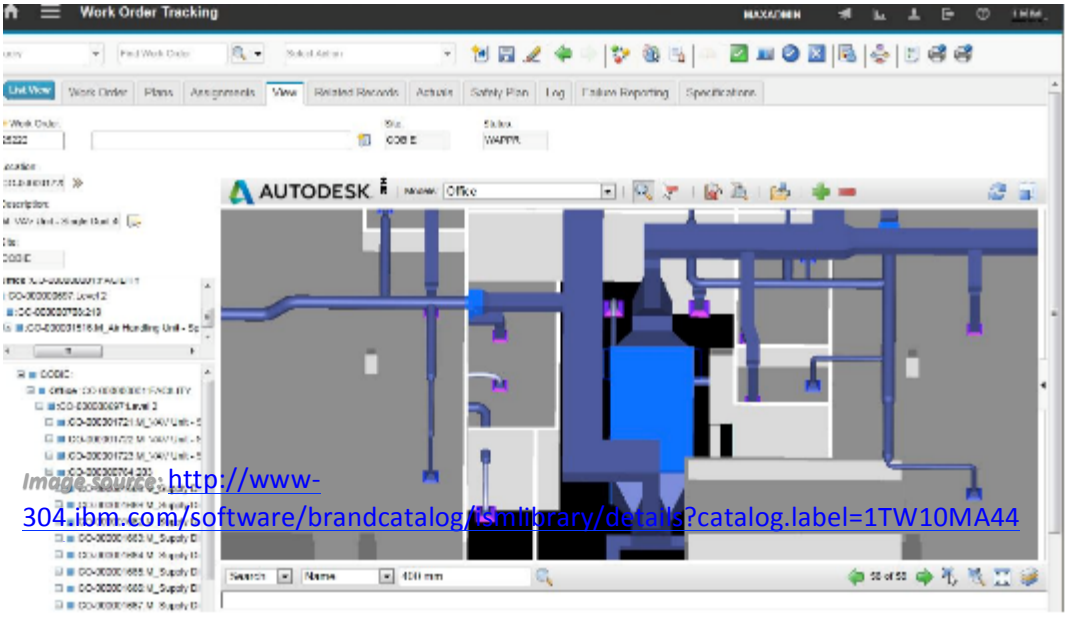


FIGURE 25: IBM MAXIMO INTEGRATED WITH AUTODESK NAVISWORKS

Facility information visualization

View and Data brings 2D sheet, 3D model and the associated data all together. There are a lot of potentials using the connected views and information. The example below runs on a web browser. On the left hand side are two views 2D and 3D, and on the right hand side data visualization dashboard is generated from the model metadata. In this example, the pie chart shows different component types, and when I picked “Ducts”, all duct components are found and highlighted in both 2D and 3D view. In facility maintenance scenario, if a mechanical technician would like to see the layout of the HVAC systems in the building, they can do this by a click and they can see right through the walls in the model. If maintenance data is captured and link to the building model, visualization techniques can be used to provide insights to building managers. For example, VAV boxes in the building can be color coded by the number of service work orders associated with them which may implicate air balancing issue for the boxes that have significantly higher frequency of maintenance activities.

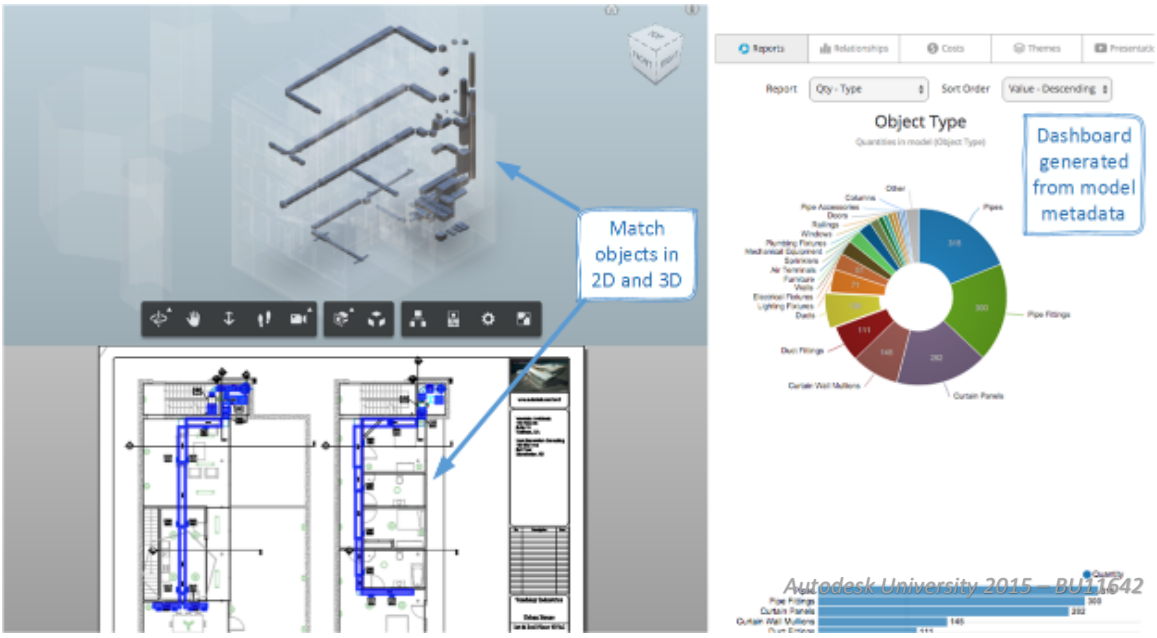


FIGURE 26: AN EXAMPLE OF VISUALIZATION LINKING MODEL AND DATA

Bi-directional linkage of model and facility data

Facilities are constantly changing – an exhaust fan was replaced, a thermostat was fixed, a hallway and offices were remodeled… With all these changes, a prefect as-built BIM gets obsolete in a few years if it does not keep updated with as-is facility data. To keep your BIM useful throughout a facility's life cycle, the information it contains should be accurate and reflect the true condition. For example, when a fan is replaced, it's properties such as install date, warranty start/end date, serial number, or even manufacturer, need to be updated correspondingly. The technologies and workflows I showed in previous section for information handover are mostly unidirectional – transferring building information from design and construction to operation and maintenance. In order to keep your model and it's metadata up to date, an ideal scenario is to build a bi-directional linkage between the model and facility database, such as CMMS database. Whenever data gets updated in facility maintenance database, it updates the same field associated with a model component. This is possible by using APIs. Autodesk BIM platforms, such as Revit and BIM 360, have open APIs which allow the bi-directional integration with external systems and 3rd party applications. Model and data created in design and construction phase can be seamlessly transferred to facility operation and maintenance applications, and new data created in operation and maintenance phase will flow back to the model and keep the model data up to date.



FIGURE 27. BI-DIRECTIONAL LINKAGE OF MODEL AND FACILITY DATA