Revit for P&IDs

A New Perspective on Design Synchronization for Water Projects | CES320823

Brian Melton | Technology Evangelist

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AUTODESK. UNIVERSITY


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Global Engineering & Construction Company
Founded in 1915
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POWER | WATER | OIL & GAS | TELECOM | FEDERAL

AGENDA

WHY

FOCUS ON WHAT WAS IMPORTANT

WHAT

WHAT DID WE PRODUCE AND WHAT WAS THE VALUE

HOW

HOW DID WE USE REVIT, DYNAMO, FORGE & MICROSOFT

NOW

LESSONS LEARNED AND NOW WHAT

Expectations

This is NOT:

- …a commercially available thing
- …a pitch to convince you to change anything

This IS:

- …a demonstration of possibilities
- …a challenge to the status-quo
- …an experiment
- …hopefully an inspiring fresh perspective

Learning Objectives

- Opportunity for Revit to successfully create intelligent schematic documents
- New opportunities for using Dynamo to support schematic documents
- How Forge & Azure help improve data access for team members

BIM in the Water Market

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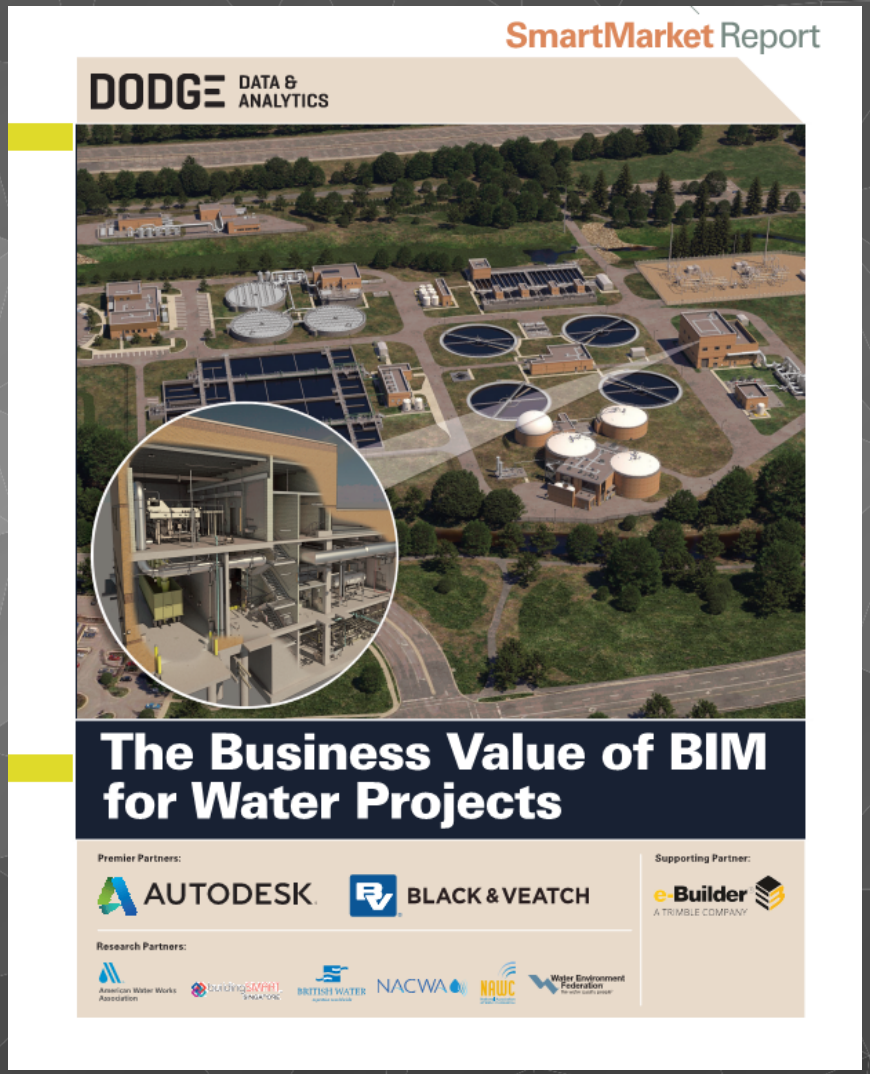
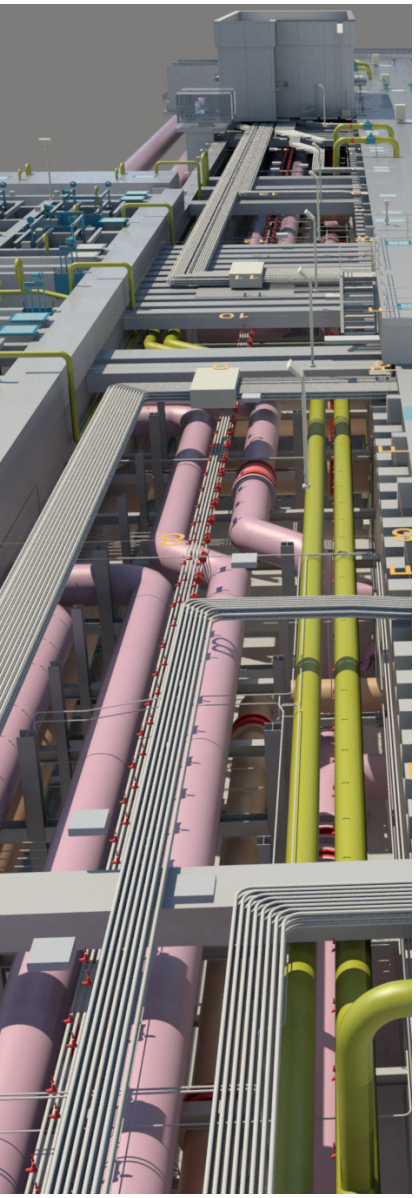
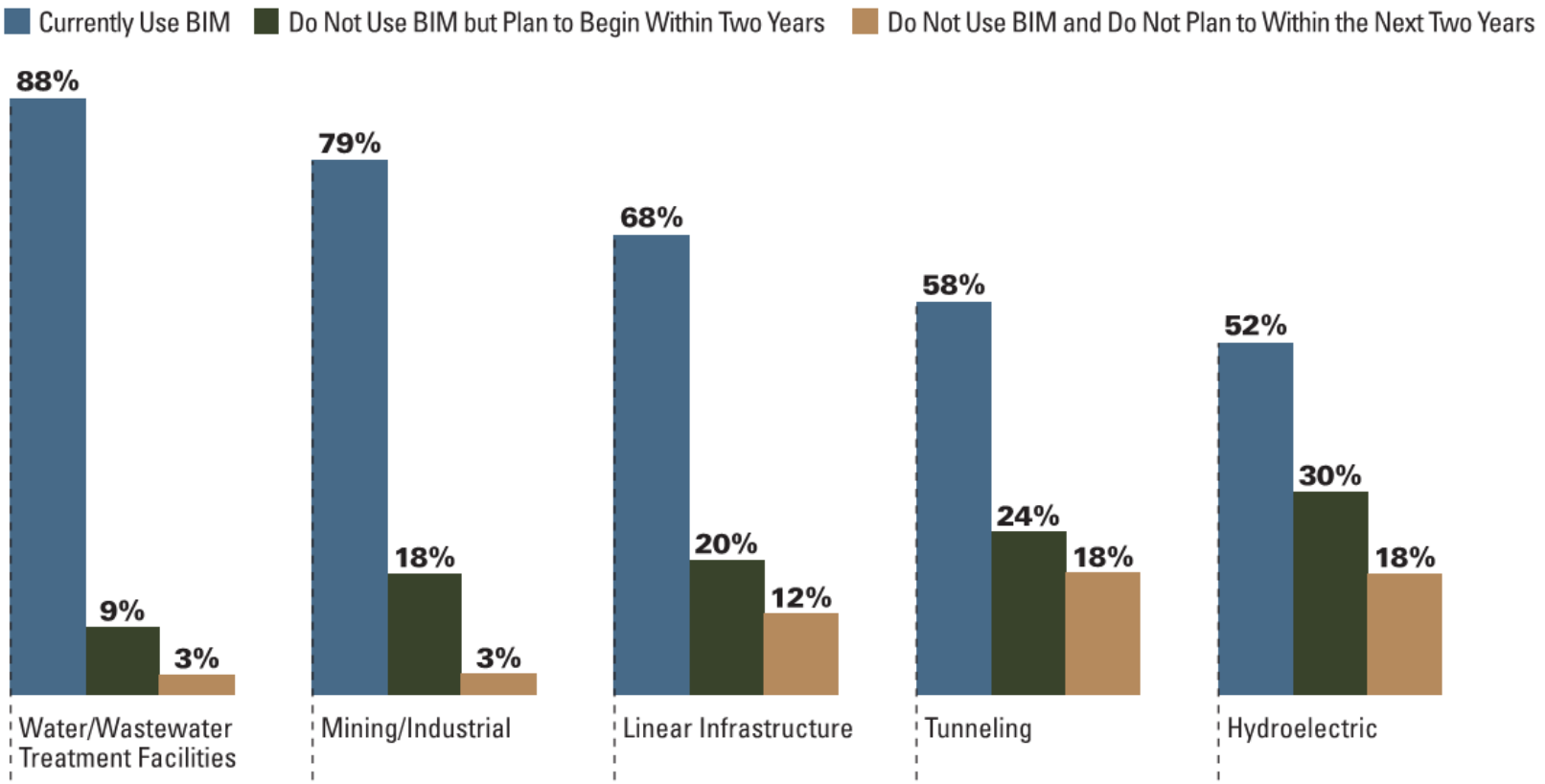


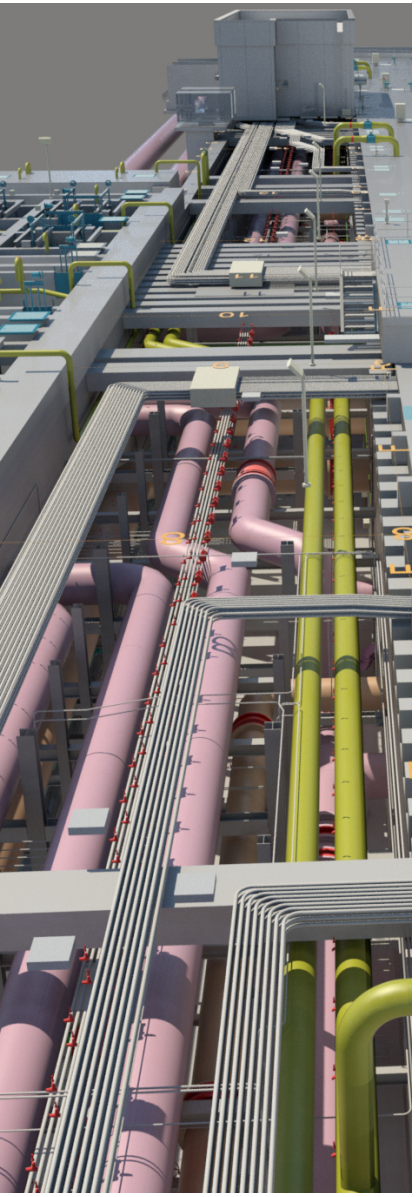


Industry Benchmark

Use of BIM by Project Type
(Current and Expected Future Use)

Dodge Data & Analytics, 2018





Industry Benchmark

Owners

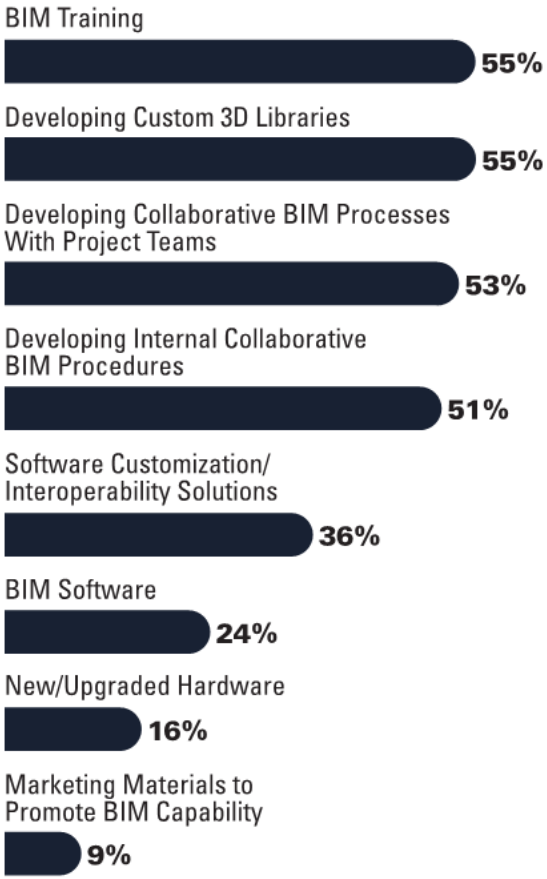
- **The highest percentage of owners (58%) expect to invest in developing BIM standards for project teams.**

Top Project Benefits of BIM Use
(According to All Respondents)

Dodge Data & Analytics, 2018

Top Investments Related to BIM
(According to Engineers and Contractors)

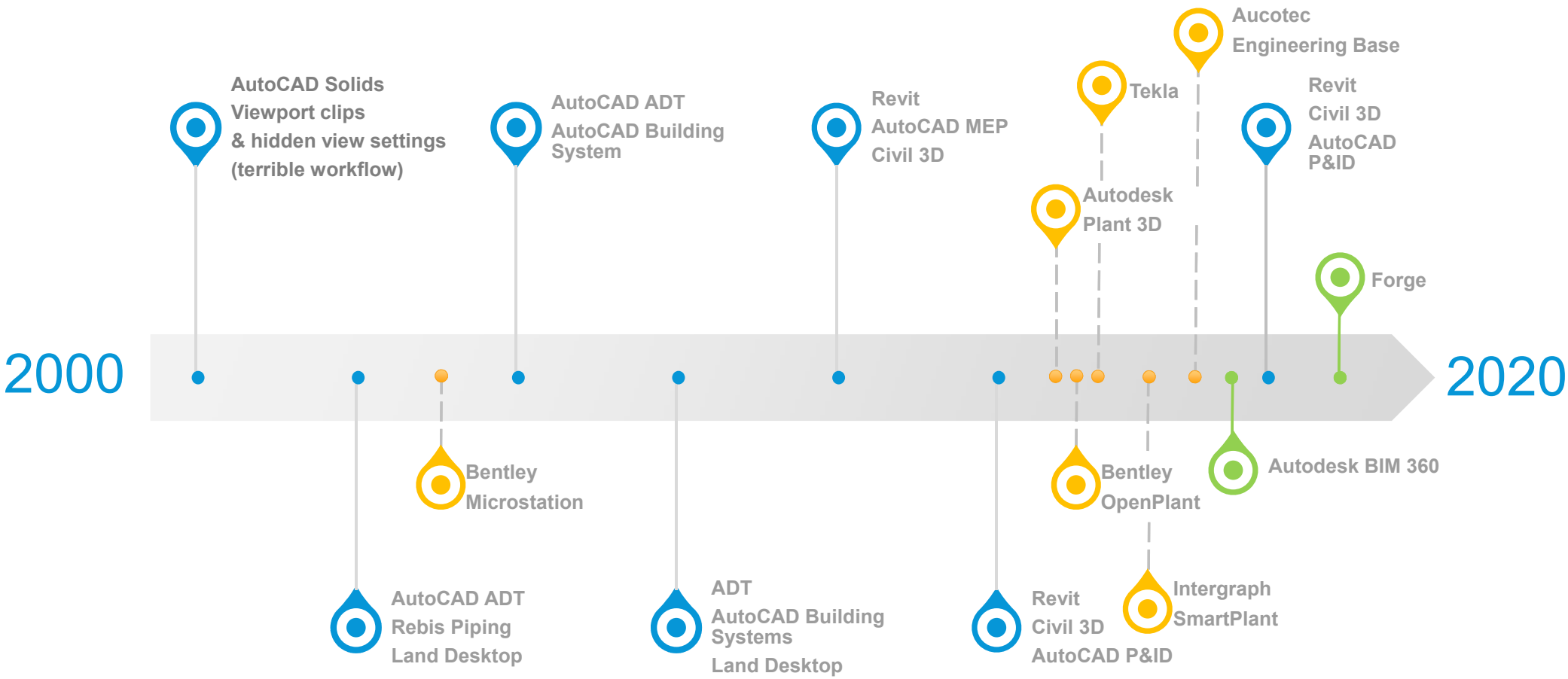
Dodge Data & Analytics, 2018



WHY

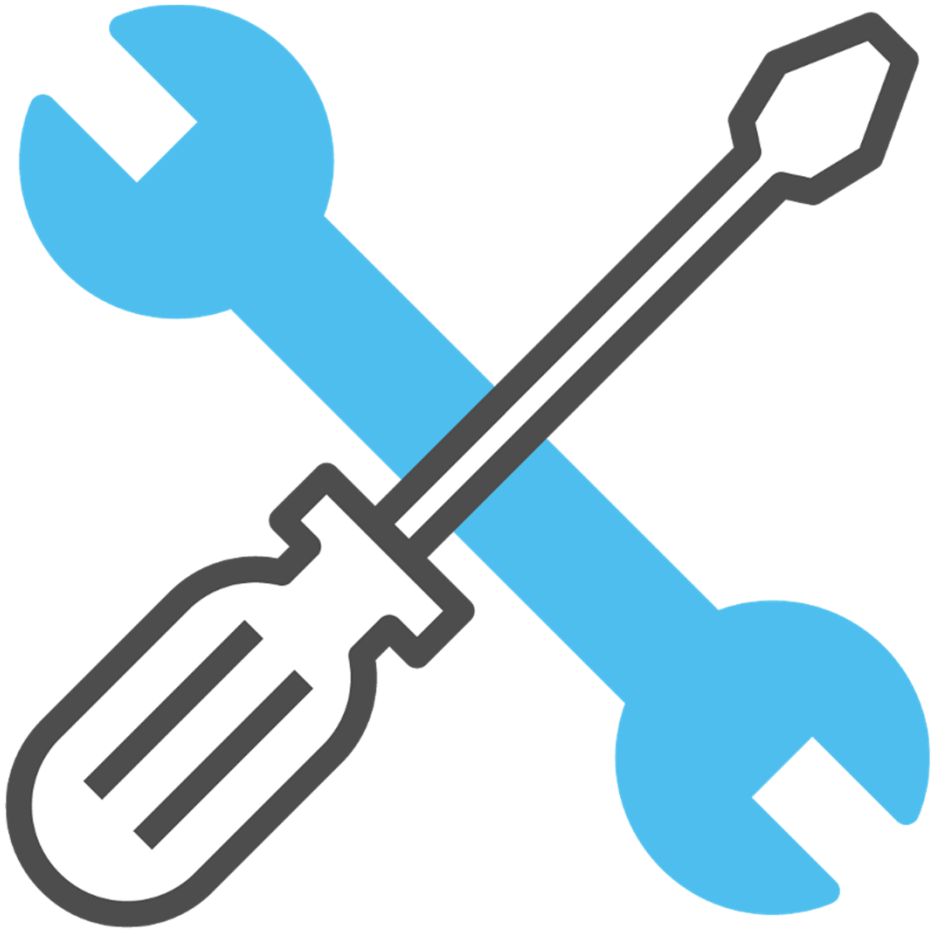
Refocus on what was important

Brief History

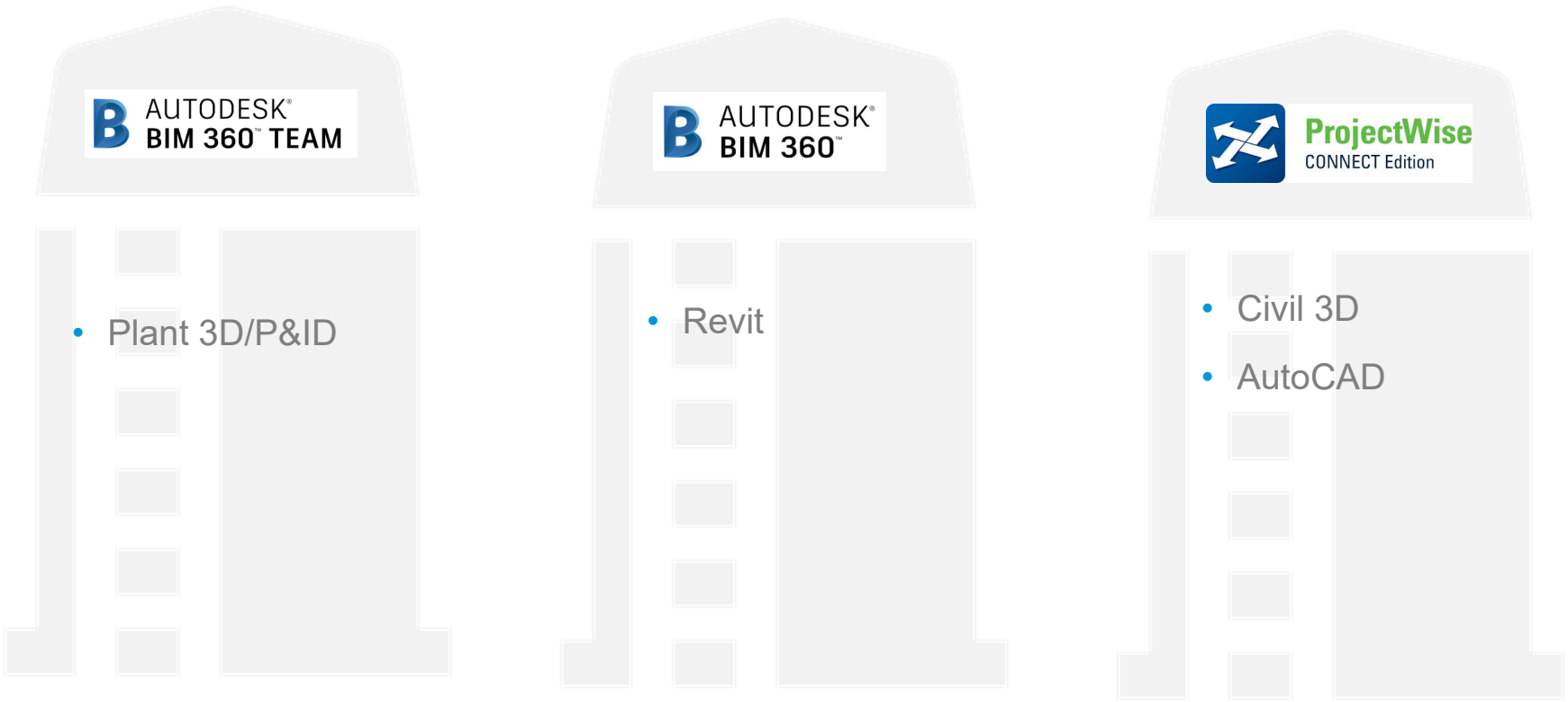


BIM for Water @ BV

- Revit
- Civil 3D
- Plant 3D
- Infraworks
- ReCAP
- Autodesk BIM 360
- ProjectWise



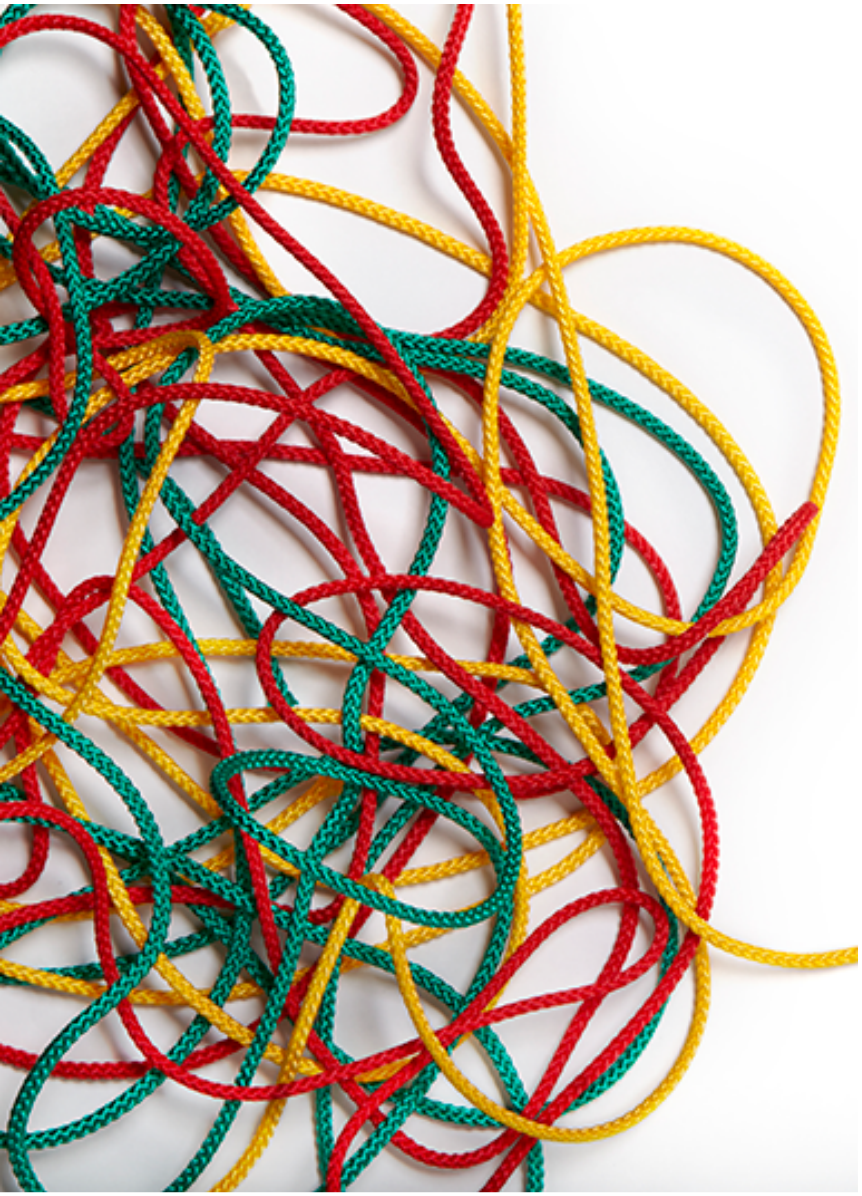
Torn Between Worlds



A view through our lens

- Autodesk most commonly used in US water market, growing usage in APAC & UK
- Revit for 3D spatial modeling (including 3D process modeling)
- Autodesk Plant 3D for schematic P&IDs only
- Microsoft Excel is main interface for the equipment data
- Civil 3D used for site & buried utilities
- Growing usage of BIM 360

YOUR PERSPECTIVE MAY DIFFER



Define the problem?

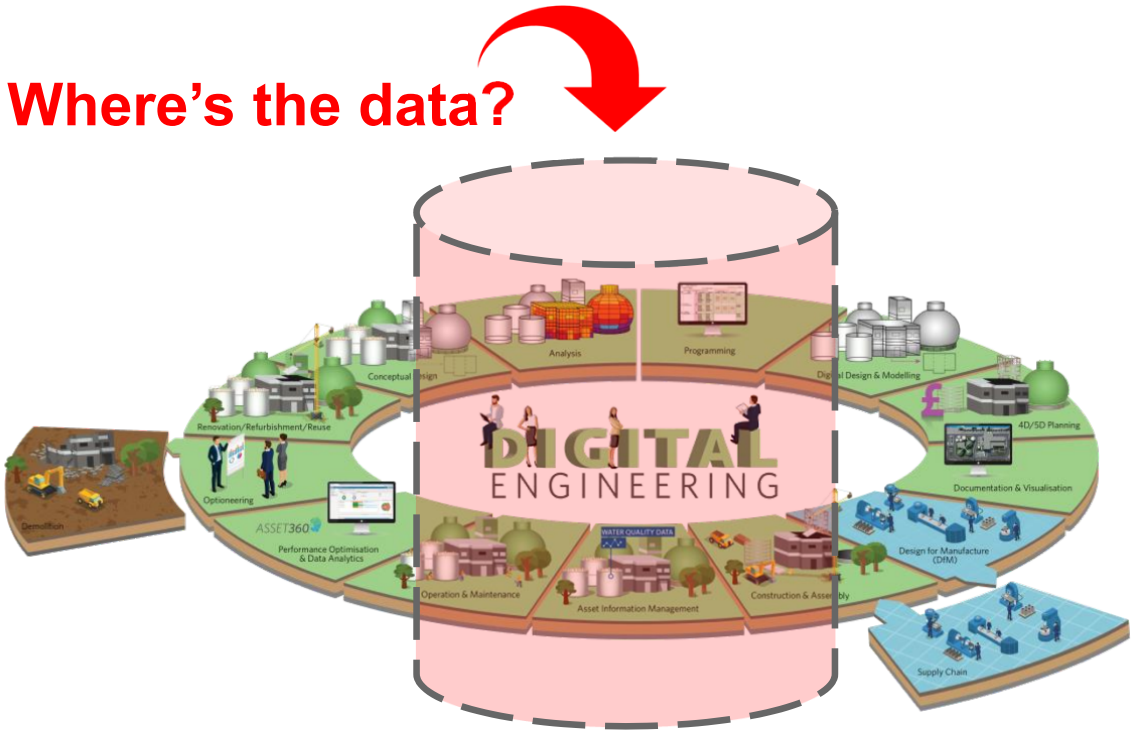
- Connectivity across project artifacts
- Difficult to get to the data
- Excel creates opportunity for errors & omissions
- Data explosion – humans can’t check it all

WHAT

There’s an app for that (now)

What We Wanted

Where's the data?

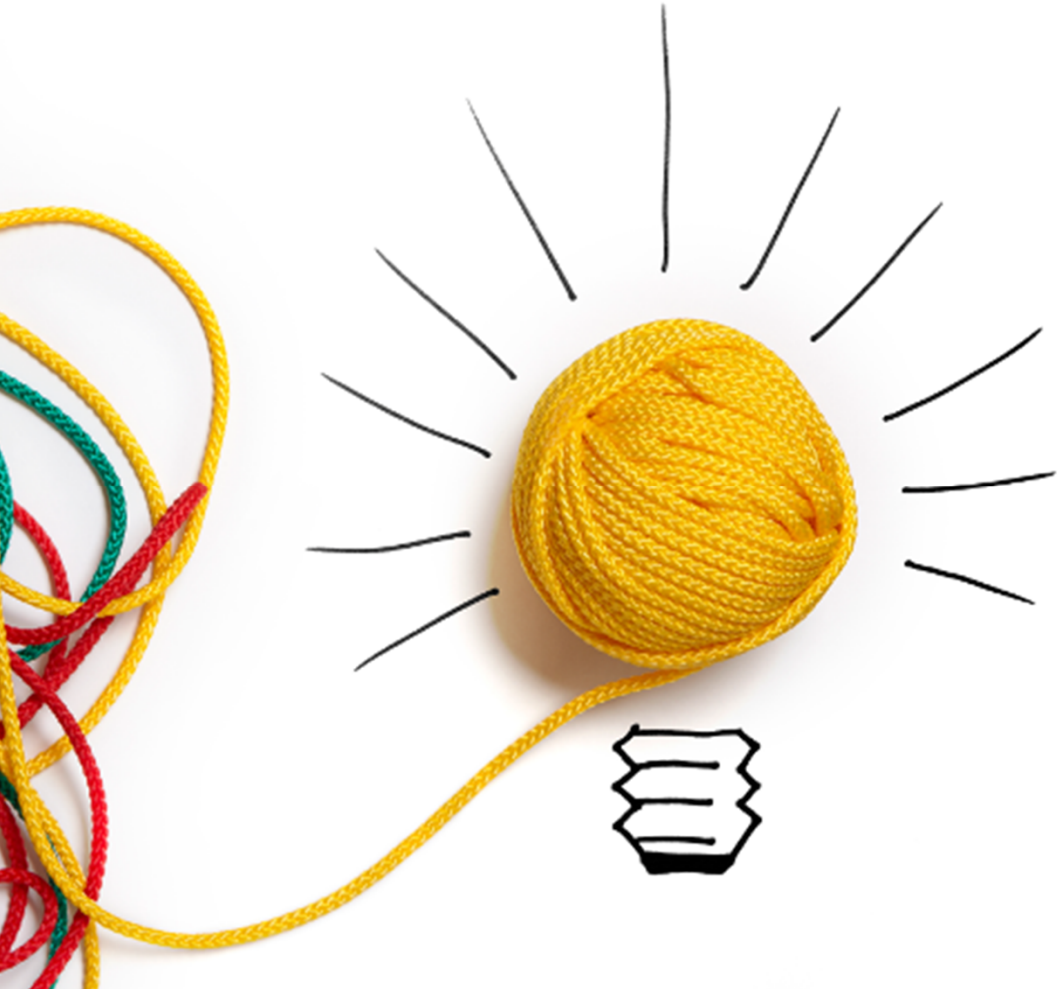


WE WANTED BIM... CENTRAL SOURCE OF DATA

REALIZATION:

- Creating data and storing data wasn't the problem
- Missing a way to manage and access data at the project level
- Value in owning the data ourselves

Refocus: What was Important to Us?



DATA-DRIVEN PROCESSES

- Real-time equipment data
- We own the data, not a specific application

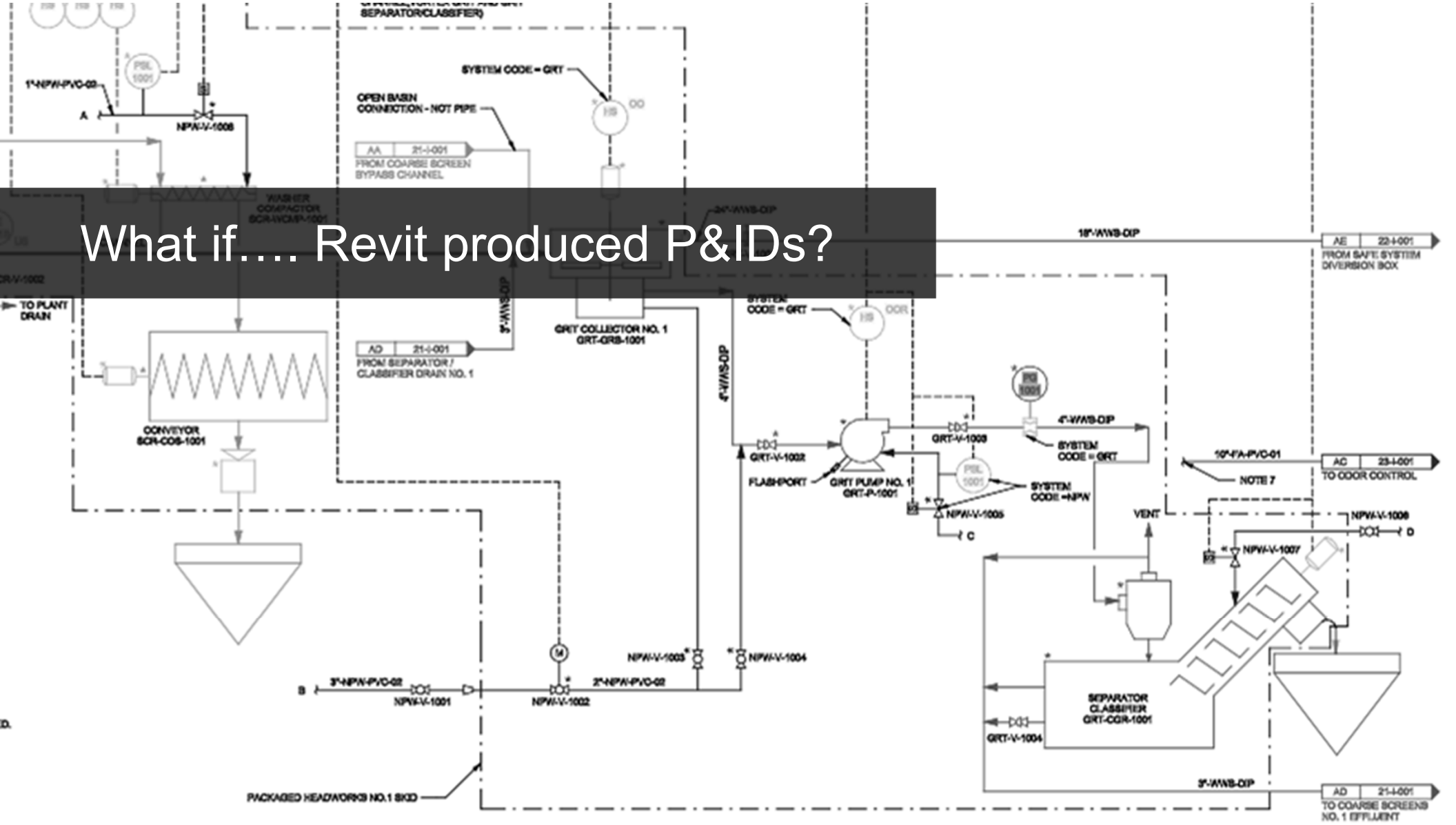
SIMPLIFIED ACCESS

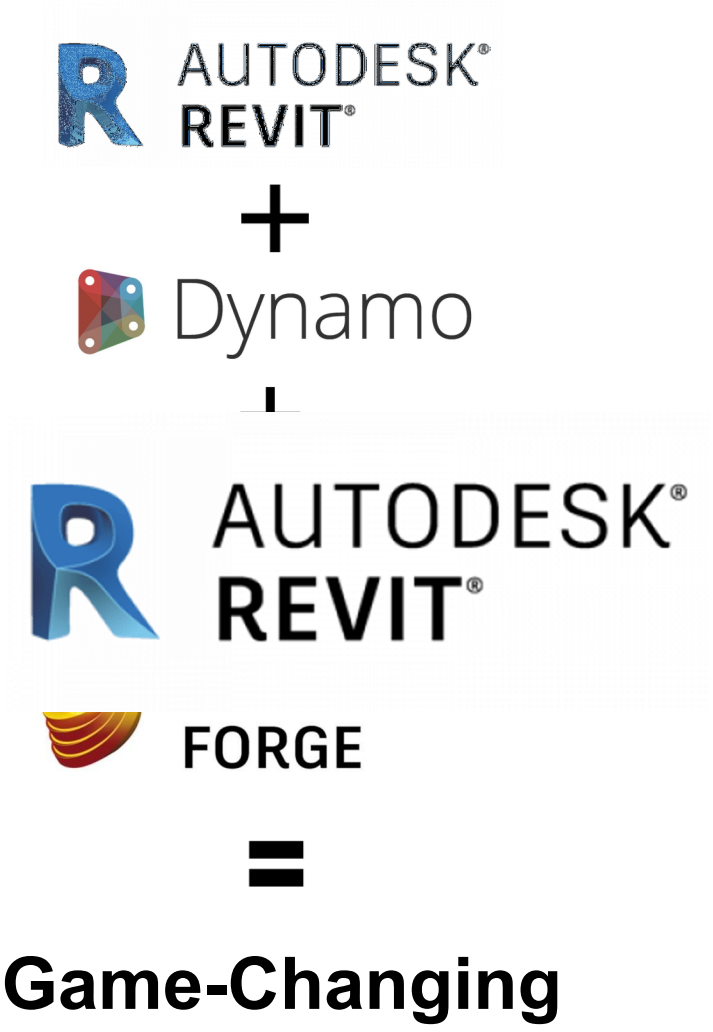
- No information should be more than a single click away

MORE CONFIDENCE IN FULLY SYNCHRONIZED DESIGN

- Improved Awareness of Sync Status
- Proactive approach for QC
- Provide automation opportunities

What if…. Revit produced P&IDs?





What makes now different?

- We weren't first, we've heard of schematics being drawn in Revit previously.
- 3rd party add-ins exist that can help facilitate some parts of the schematic production within Revit
- Revit by itself, was interesting but not "game-changing"

Morro Bay Water Reclamation Facility

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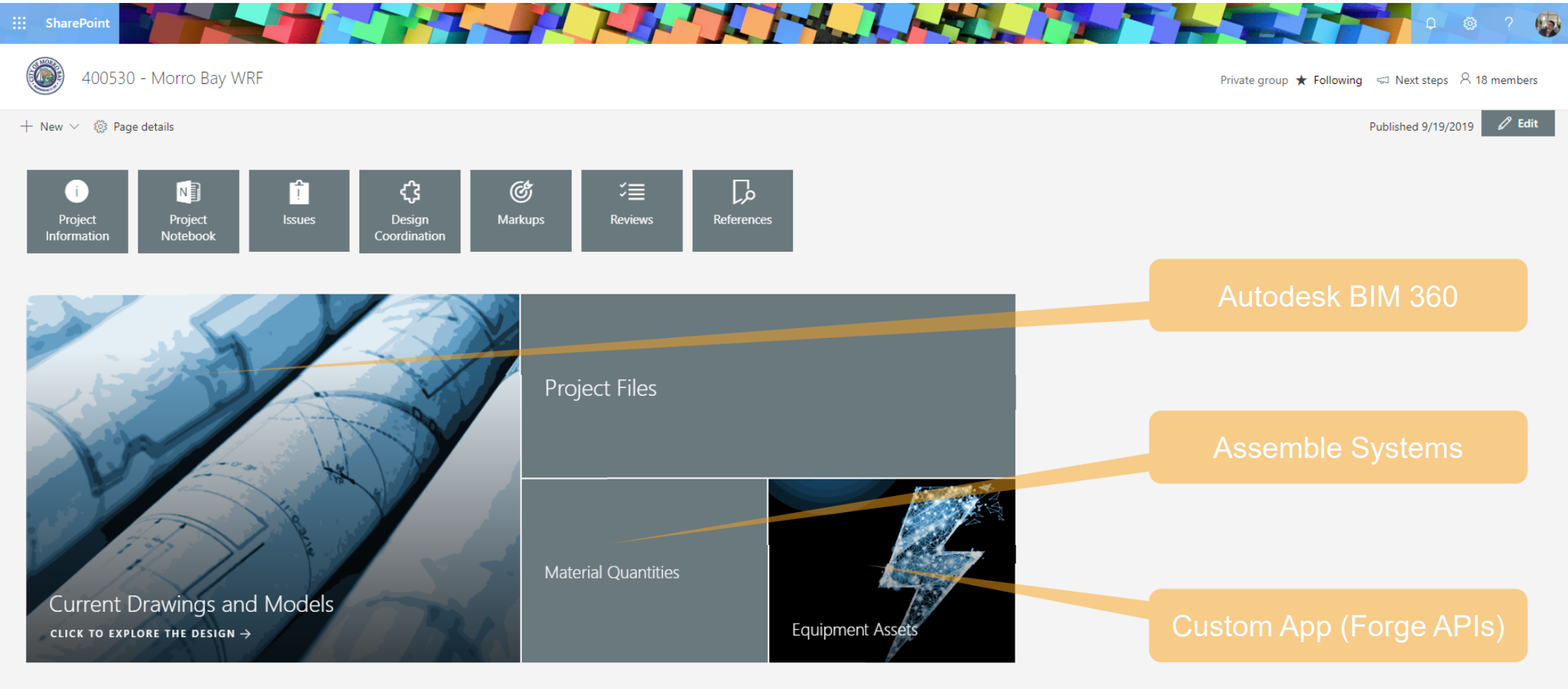
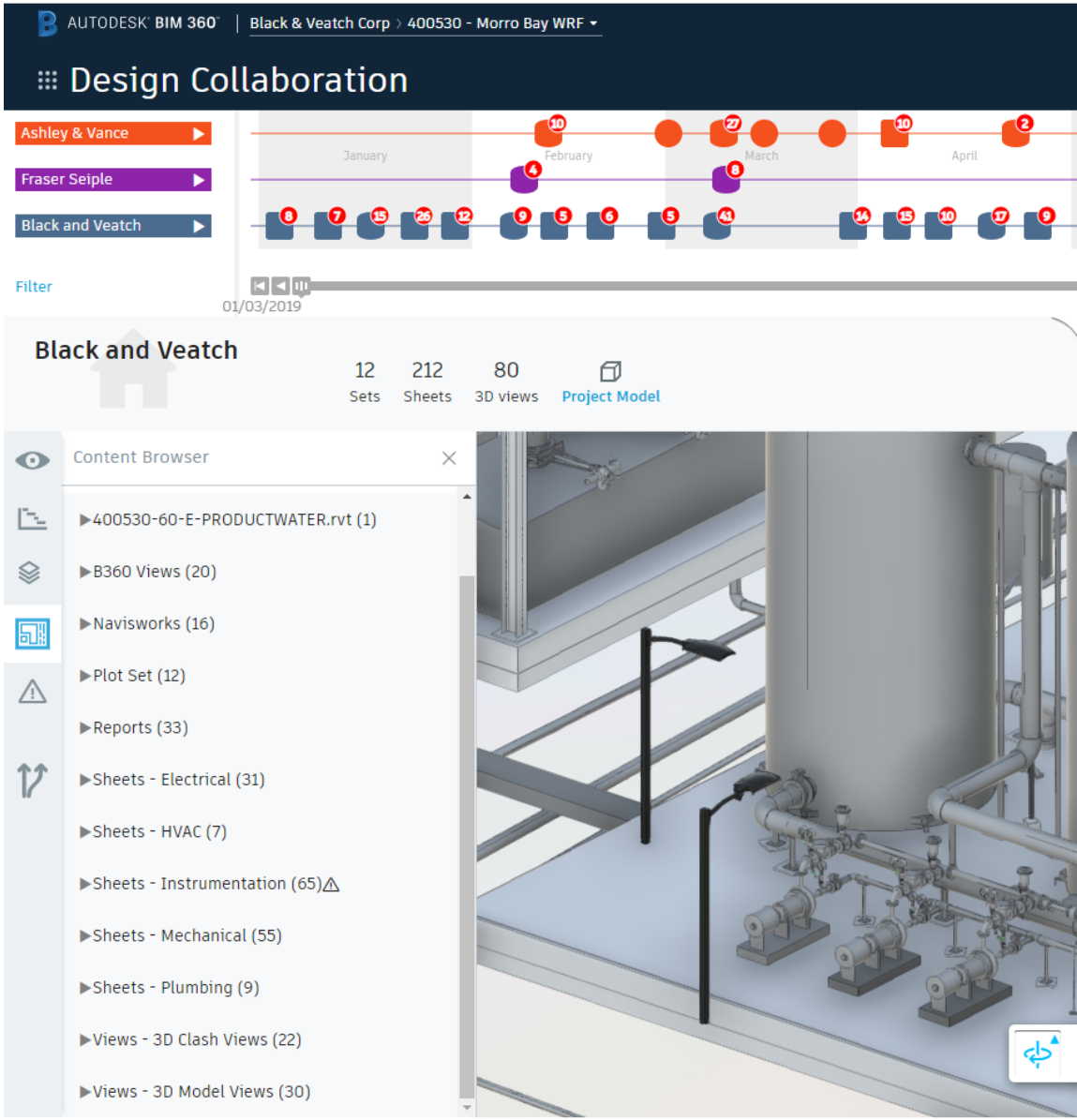
Design + Construction Schedule 2018 - 2021

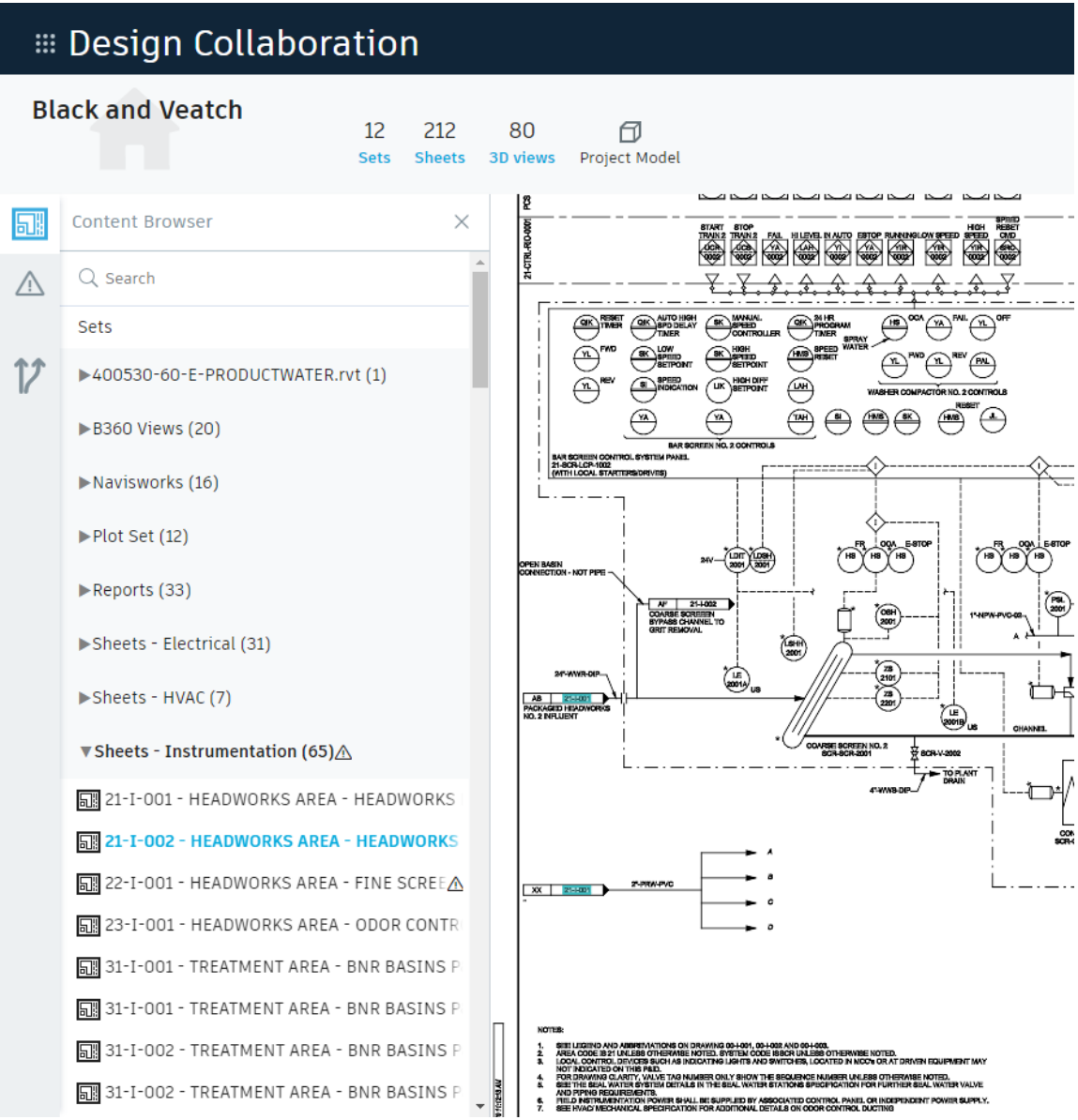

SharePoint
400530 - Morro Bay WRF
Private group
Following
Next steps
18 members
New
Page details
Published 9/19/2019
Edit
Project Information
Project Notebook
Issues
Design Coordination
Markups
Reviews
References
Current Drawings and Models
CLICK TO EXPLORE THE DESIGN
Project Files
Material Quantities
Equipment Assets
Autodesk BIM 360
Assemble Systems
Custom App (Forge APIs)

BIM 360 Out-of-the-Box

It works, use Revit & BIM 360

- Hosted workshared files
- Facilitated collaboration between several parties
- Simplified viewing of models and drawings via Web
- Provided Opportunity to use Forge





BIM 360 Out-of-the-Box

Consolidating Design Platforms Added Value

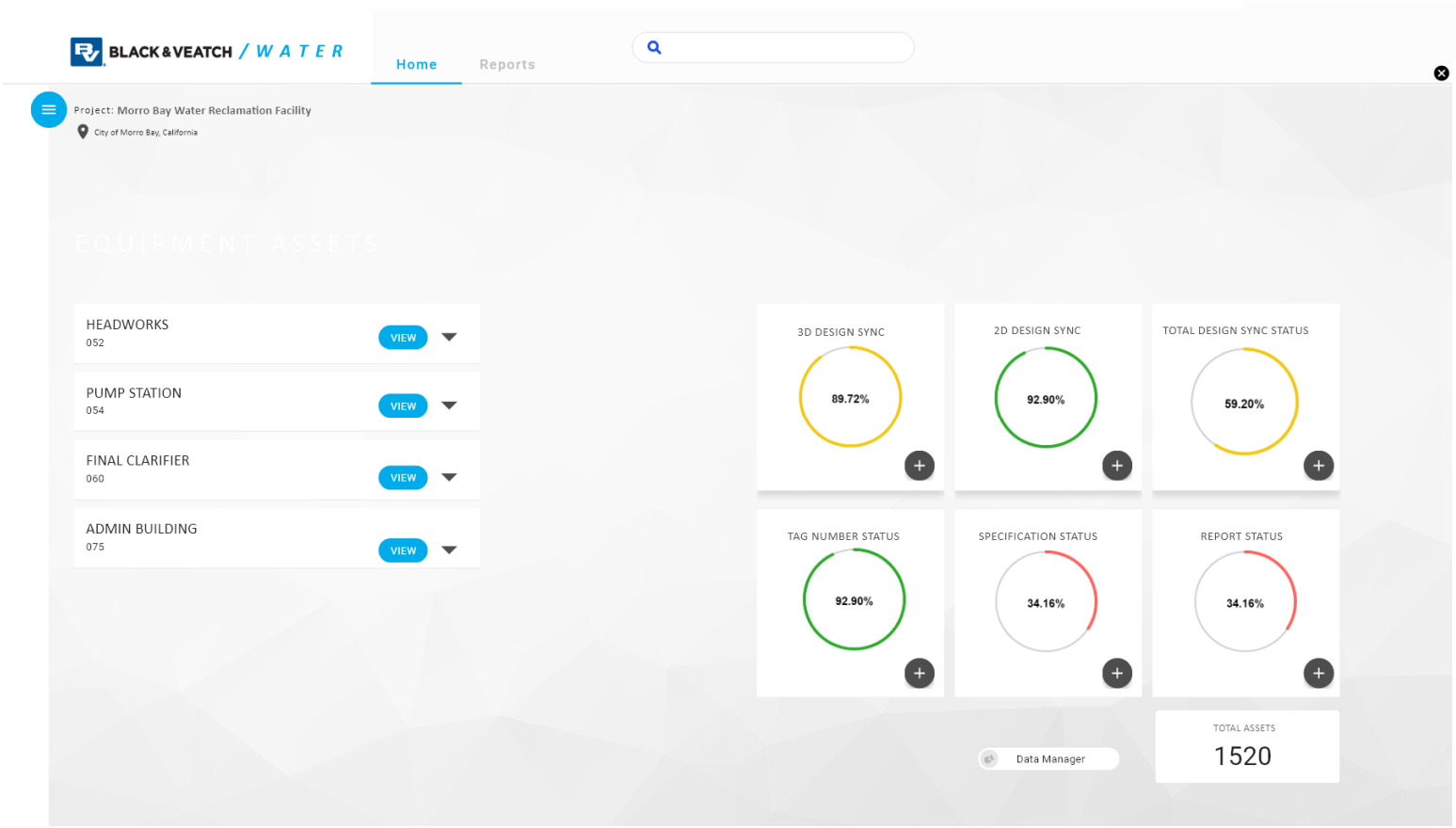
- P&ID drawings via same web project as Revit data
- Intelligent Navigation
- Drawing Index Sheets

Custom App | **OneClick**

AUTODESK® FORGE

Microsoft Azure

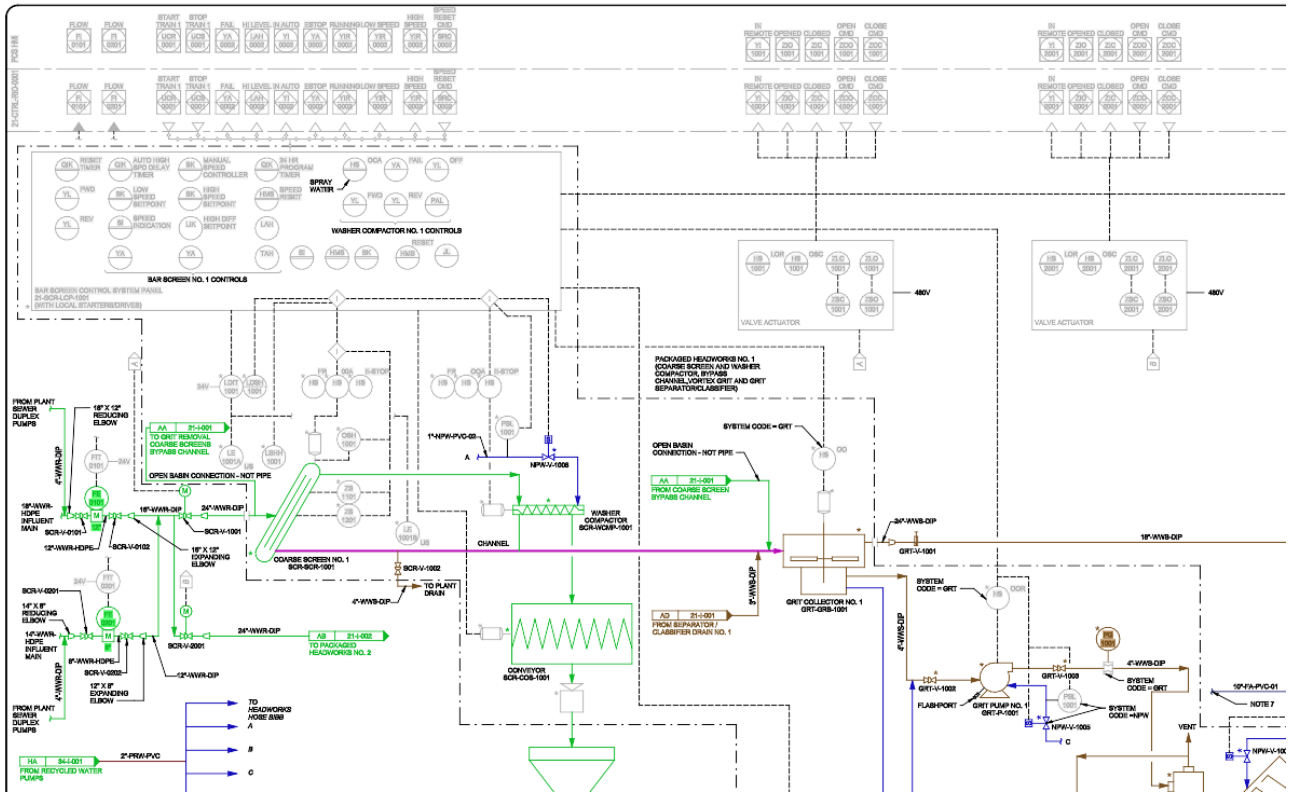
- Real-time data
- Simplified access



Forge App | Visualize & Interact with Data

What does data-driven look like?

- Change how people can visually see and explore data



BLACK & VEATCH Dashboard Reports

Search tag numbers

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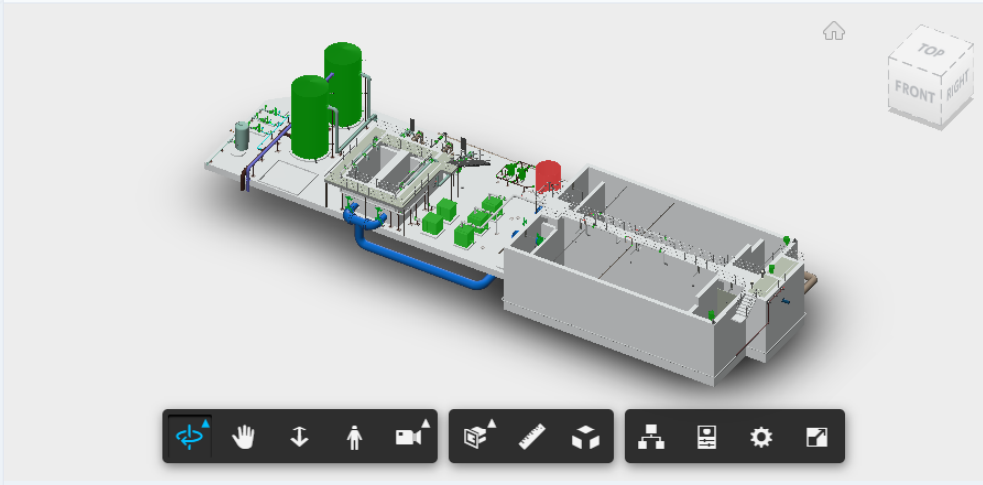
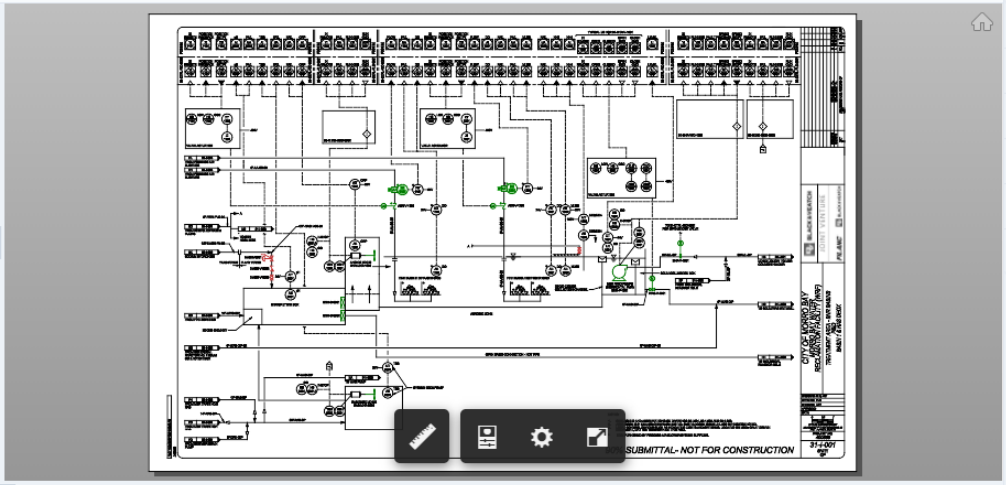
Properties

31-I-001 - TREATMENT AREA -





40 64 00 Input/Output (I/O)

Location: 30-MBR : V 87 Last Modified: 2019-11-02

Filter by drawing

- Select a report
- Master Equipment List
- Valve Report
- 40 05 68 (S01) Check Valve
- 40 05 64 22 (S01) Industrial Butterfly Valve (Manual)
- 40 64 00 Input/Output (I/O)
- 40 61 11 Instrument Device List
- 40 05 63.53 (S01) Miscellaneous Ball Valves (Manual)
- 40 05 63.53 (SO2) Miscellaneous Ball Valves (Electric)
- 40 05 62.16 (S01) Eccentric Plug Valves (Manual)
- Pipes with Undefined Material Code2
- 40 05 00-S01_Gate Valves
- 40 05 00 (S01) Pressure Sustaining
- 40 05 01 (S01) Needle Valves
- 40 05 02 (S01) Pressure Relief
- 40 05 03 (S01) V-Port Ball Valves
- 40 05 59.26 (S01) Cast Iron Slide Gates (Manual)
- 40 05 61.43 (S01) Knife Gate Valves (Manual)
- 40 05 61.43 (S02) Knife Gate Valves (Electric)
- 40 05 62.16 (S02) Eccentric Plug Valves (Electric)

		Item Number	I/O Type	Description	Field Device	Controller ID	Service Description	Analog Signal Type	Analog Range	Analog Pc
		0	AO	SPEED SETPT	VFD1001	80-CTRL-PLC-0001	BASIN 1 MBR FEED PUMP SPEED SETPT	4-20 mA		2-WIRE
		0	DI	IN REMOTE	V-1001	31-CTRL-RIO-0001	BASIN 1 SCUM COLLECTION BOX TO WAS WETWELL ISO VALVE IN REMOTE	NA	NA	NA
		0	DI	OPEN	V-1001	31-CTRL-RIO-0001	BASIN 1 SCUM COLLECTION BOX TO WAS WETWELL ISO VALVE OPENED	NA	NA	NA
		0	DI	CLOSED	V-1001	31-CTRL-RIO-0001	BASIN 1 SCUM COLLECTION BOX TO WAS WETWELL ISO VALVE CLOSED	NA	NA	NA
		0	DO	OPEN CMD	V-1001	31-CTRL-RIO-0001	BASIN 1 SCUM COLLECTION BOX TO WAS WETWELL ISO VALVE OPEN COMMAND	NA	NA	NA
		0	DO	CLOSE CMD	V-1001	31-CTRL-RIO-0001	BASIN 1 SCUM COLLECTION BOX TO WAS WETWELL ISO VALVE CLOSE COMMAND			
		0	DI	IN REMOTE	31-BNR-V-1001	31-RIO-0001		NA	NA	NA
		0	DI	OPEN	31-BNR-V-1001	31-RIO-0001		NA	NA	NA
		0	DI	CLOSED	31-BNR-V-1001	31-RIO-0001		NA	NA	NA
		0	DO	OPEN CMD	31-BNR-V-1001	31-RIO-0001	BASIN 1 SCUM COLLECTION BOX TO WAS WETWELL ISO VALVE OPEN COMMAND	NA	NA	NA
31-BNR-ZCC-1001	31-BNR-1001	0	DO	CLOSE CMD	31-BNR-V-1001	31-RIO-0001	BASIN 1 SCUM COLLECTION BOX TO WAS WETWELL ISO VALVE CLOSE COMMAND			

BLACK & VEATCH Dashboard Reports

Search tag numbers

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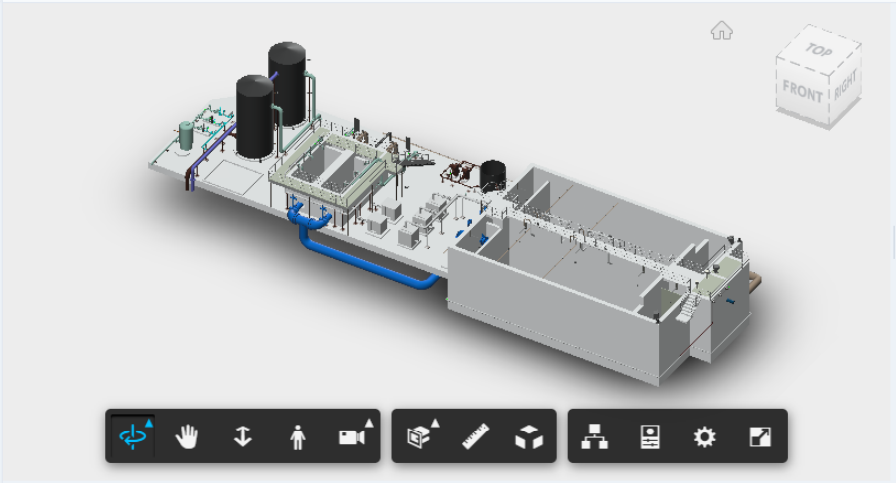
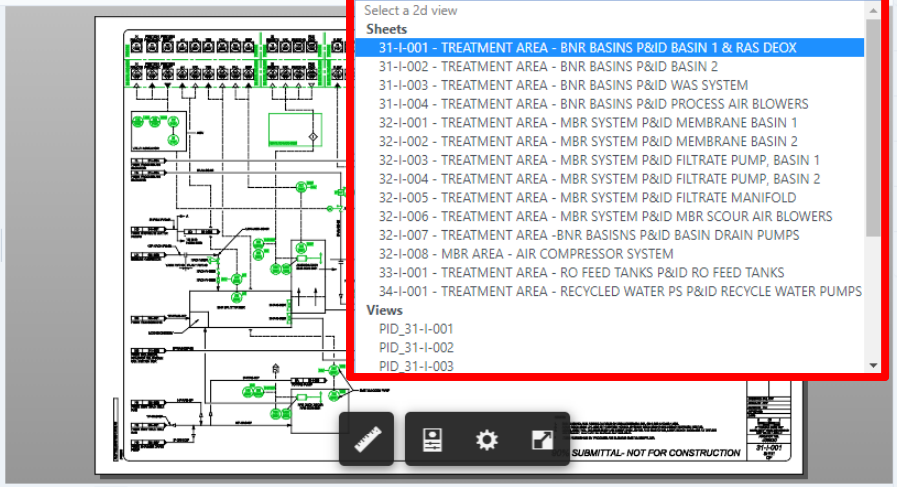




31-I-001 - TREATMENT AREA -

Select a 2d view

Sheets

- 31-I-001 - TREATMENT AREA - BNR BASINS P&ID BASIN 1 & RAS DEOX
- 31-I-002 - TREATMENT AREA - BNR BASINS P&ID BASIN 2
- 31-I-003 - TREATMENT AREA - BNR BASINS P&ID WAS SYSTEM
- 31-I-004 - TREATMENT AREA - BNR BASINS P&ID PROCESS AIR BLOWERS
- 32-I-001 - TREATMENT AREA - MBR SYSTEM P&ID MEMBRANE BASIN 1
- 32-I-002 - TREATMENT AREA - MBR SYSTEM P&ID MEMBRANE BASIN 2
- 32-I-003 - TREATMENT AREA - MBR SYSTEM P&ID FILTRATE PUMP, BASIN 1
- 32-I-004 - TREATMENT AREA - MBR SYSTEM P&ID FILTRATE PUMP, BASIN 2
- 32-I-005 - TREATMENT AREA - MBR SYSTEM P&ID FILTRATE MANIFOLD
- 32-I-006 - TREATMENT AREA - MBR SYSTEM P&ID MBR SCOUR AIR BLOWERS
- 32-I-007 - TREATMENT AREA -BNR BASISNS P&ID BASIN DRAIN PUMPS
- 32-I-008 - MBR AREA - AIR COMPRESSOR SYSTEM
- 33-I-001 - TREATMENT AREA - RO FEED TANKS P&ID RO FEED TANKS
- 34-I-001 - TREATMENT AREA - RECYCLED WATER PS P&ID RECYCLE WATER PUMPS

Views

- PID_31-I-001
- PID_31-I-002
- PID_31-I-003

Color Options

Installed By

Quality Control

Choose color option

Color Property

ex: DES_Sub Classification

Exists | Value

Clear Coloring

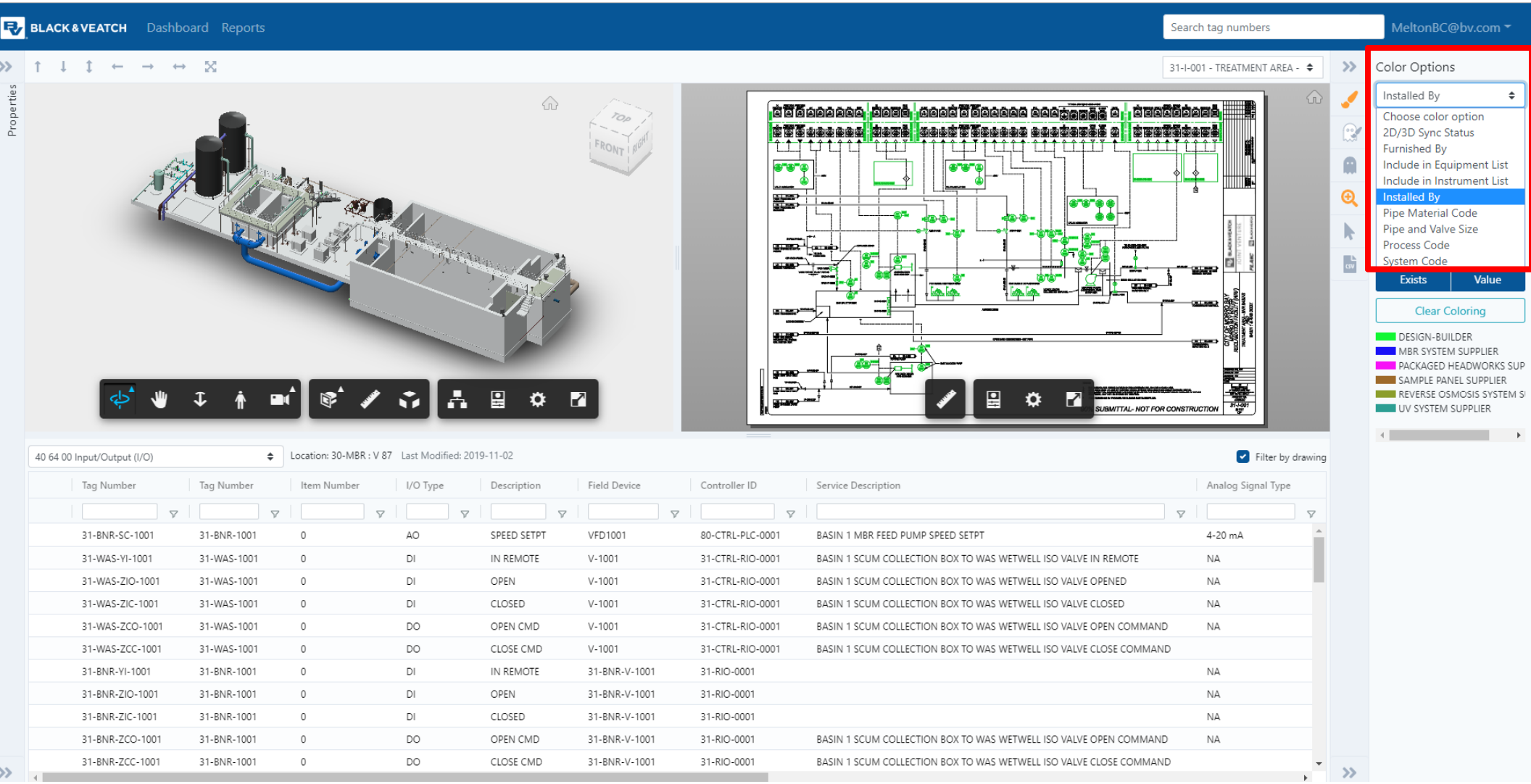
- DESIGN-BUILDER
- MBR SYSTEM SUPPLIER
- PACKAGED HEADWORKS SUP
- SAMPLE PANEL SUPPLIER
- REVERSE OSMOSIS SYSTEM S
- UV SYSTEM SUPPLIER

40 64 00 Input/Output (I/O)

Location: 30-MBR : V 87 Last Modified: 2019-11-02

Filter by drawing

Tag Number	Tag Number	Item Number	I/O Type	Description	Field Device	Controller ID	Service Description	Analog Signal Type
31-BNR-SC-1001	31-BNR-1001	0	AO	SPEED SETPT	VFD1001	80-CTRL-PLC-0001	BASIN 1 MBR FEED PUMP SPEED SETPT	4-20 mA
31-WAS-YI-1001	31-WAS-1001	0	DI	IN REMOTE	V-1001	31-CTRL-RIO-0001	BASIN 1 SCUM COLLECTION BOX TO WAS WETWELL ISO VALVE IN REMOTE	NA
31-WAS-ZIO-1001	31-WAS-1001	0	DI	OPEN	V-1001	31-CTRL-RIO-0001	BASIN 1 SCUM COLLECTION BOX TO WAS WETWELL ISO VALVE OPENED	NA
31-WAS-ZIC-1001	31-WAS-1001	0	DI	CLOSED	V-1001	31-CTRL-RIO-0001	BASIN 1 SCUM COLLECTION BOX TO WAS WETWELL ISO VALVE CLOSED	NA
31-WAS-ZCO-1001	31-WAS-1001	0	DO	OPEN CMD	V-1001	31-CTRL-RIO-0001	BASIN 1 SCUM COLLECTION BOX TO WAS WETWELL ISO VALVE OPEN COMMAND	NA
31-WAS-ZCC-1001	31-WAS-1001	0	DO	CLOSE CMD	V-1001	31-CTRL-RIO-0001	BASIN 1 SCUM COLLECTION BOX TO WAS WETWELL ISO VALVE CLOSE COMMAND	
31-BNR-YI-1001	31-BNR-1001	0	DI	IN REMOTE	31-BNR-V-1001	31-RIO-0001		NA
31-BNR-ZIO-1001	31-BNR-1001	0	DI	OPEN	31-BNR-V-1001	31-RIO-0001		NA
31-BNR-ZIC-1001	31-BNR-1001	0	DI	CLOSED	31-BNR-V-1001	31-RIO-0001		NA
31-BNR-ZCO-1001	31-BNR-1001	0	DO	OPEN CMD	31-BNR-V-1001	31-RIO-0001	BASIN 1 SCUM COLLECTION BOX TO WAS WETWELL ISO VALVE OPEN COMMAND	NA
31-BNR-ZCC-1001	31-BNR-1001	0	DO	CLOSE CMD	31-BNR-V-1001	31-RIO-0001	BASIN 1 SCUM COLLECTION BOX TO WAS WETWELL ISO VALVE CLOSE COMMAND	



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31-WAS-ZIO-1001	31-WAS-1001	0	DI	OPEN	V-1001	31-CTRL-RIO-0001	BASIN 1 SCUM COLLECTION BOX TO WAS WETWELL ISO VALVE OPENED	NA
31-WAS-ZIC-1001	31-WAS-1001	0	DI	CLOSED	V-1001	31-CTRL-RIO-0001	BASIN 1 SCUM COLLECTION BOX TO WAS WETWELL ISO VALVE CLOSED	NA
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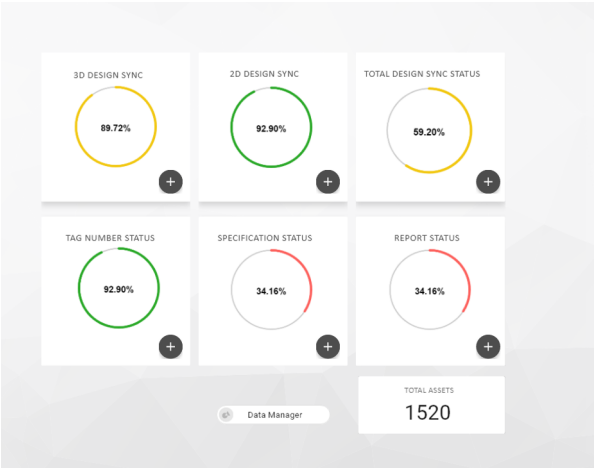
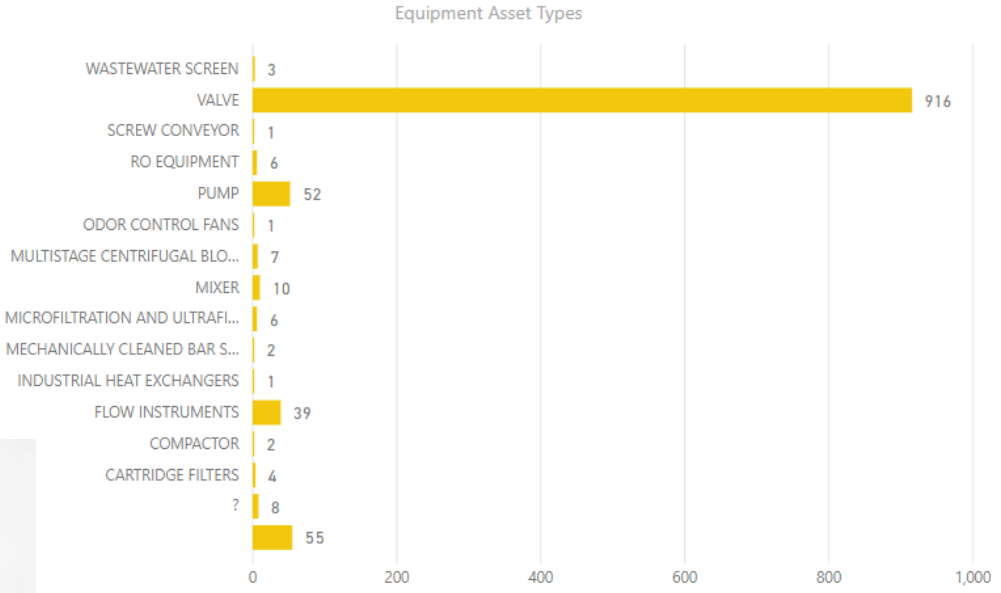
31-WAS-ZCC-1001	31-WAS-1001	0	DO	CLOSE CMD	V-1001	31-CTRL-RIO-0001	BASIN 1 SCUM COLLECTION BOX TO WAS WETWELL ISO VALVE CLOSE COMMAND	
31-BNR-YI-1001	31-BNR-1001	0	DI	IN REMOTE	31-BNR-V-1001	31-RIO-0001		NA
31-BNR-ZIO-1001	31-BNR-1001	0	DI	OPEN	31-BNR-V-1001	31-RIO-0001		NA
31-BNR-ZIC-1001	31-BNR-1001	0	DI	CLOSED	31-BNR-V-1001	31-RIO-0001		NA
31-BNR-ZCO-1001	31-BNR-1001	0	DO	OPEN CMD	31-BNR-V-1001	31-RIO-0001	BASIN 1 SCUM COLLECTION BOX TO WAS WETWELL ISO VALVE OPEN COMMAND	NA
31-BNR-ZCC-1001	31-BNR-1001	0	DO	CLOSE CMD	31-BNR-V-1001	31-RIO-0001	BASIN 1 SCUM COLLECTION BOX TO WAS WETWELL ISO VALVE CLOSE COMMAND	

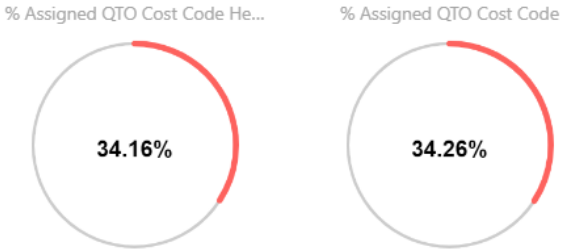
Forge App | Proactive Quality Control

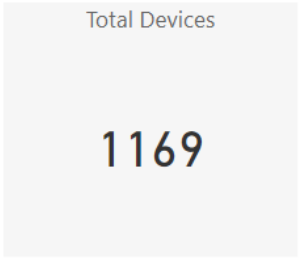
What does data-driven look like?

- Use the data to understand project health







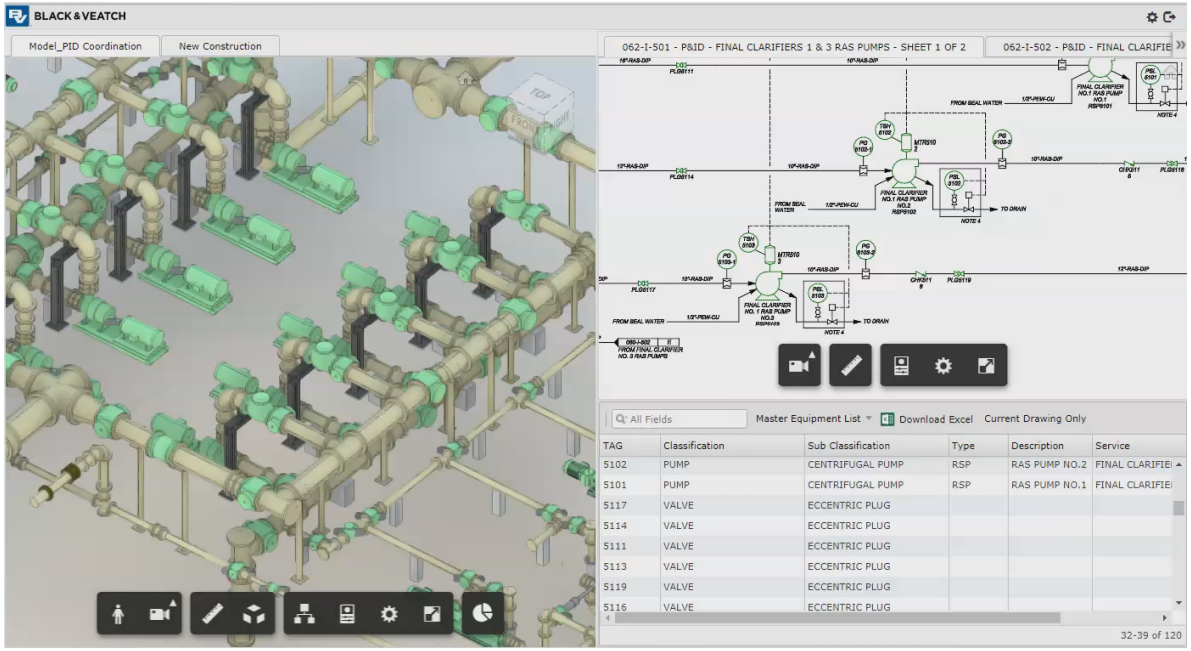


HOW

Innovate and Experiment

DO SOMETHING, LEARN SOMETHING

First we Prototyped it…. Prove it



Rapid prototype:

- Assistance Autodesk Forge Team
- Few conference calls
- 2-3 sprint cycles
- Relatively quick POC

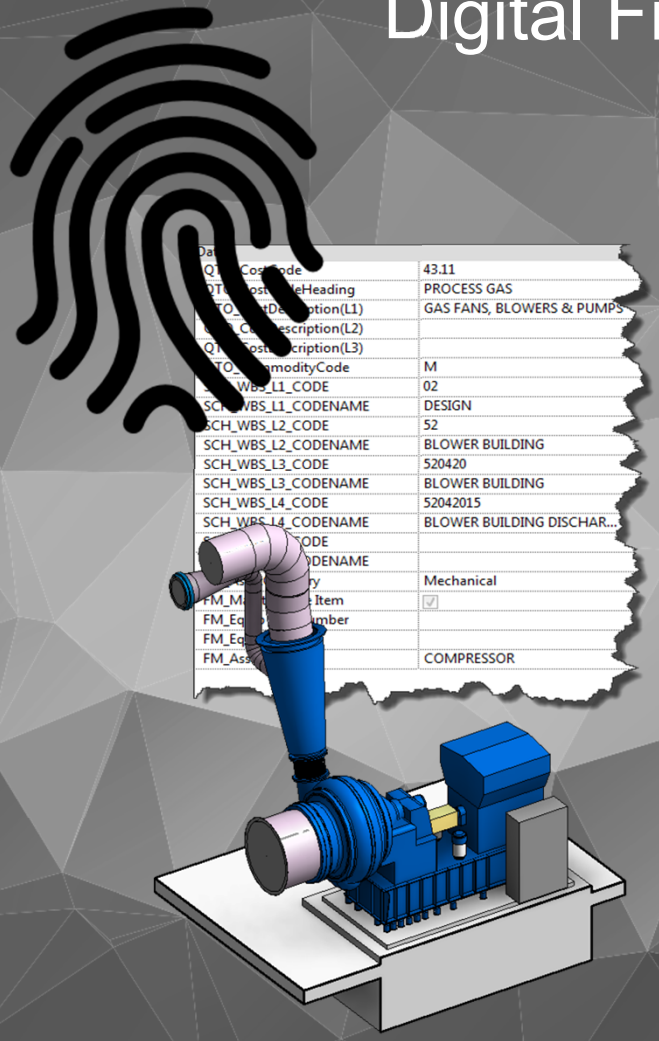
Scaled Solution… Plan it.

- Worked with Autodesk Consulting
- Couple of workshops

Assembled a team… Do it

- Built internal team of several full-stack developers
- Autodesk consulting provided a few days of training on Forge APIs (via PAC credits)
- Learned agile scrum process on-the-fly
- 3 week sprint cycles
- MSFT DevOps supporting development workflows

Digital Fingerprint for a Water Project

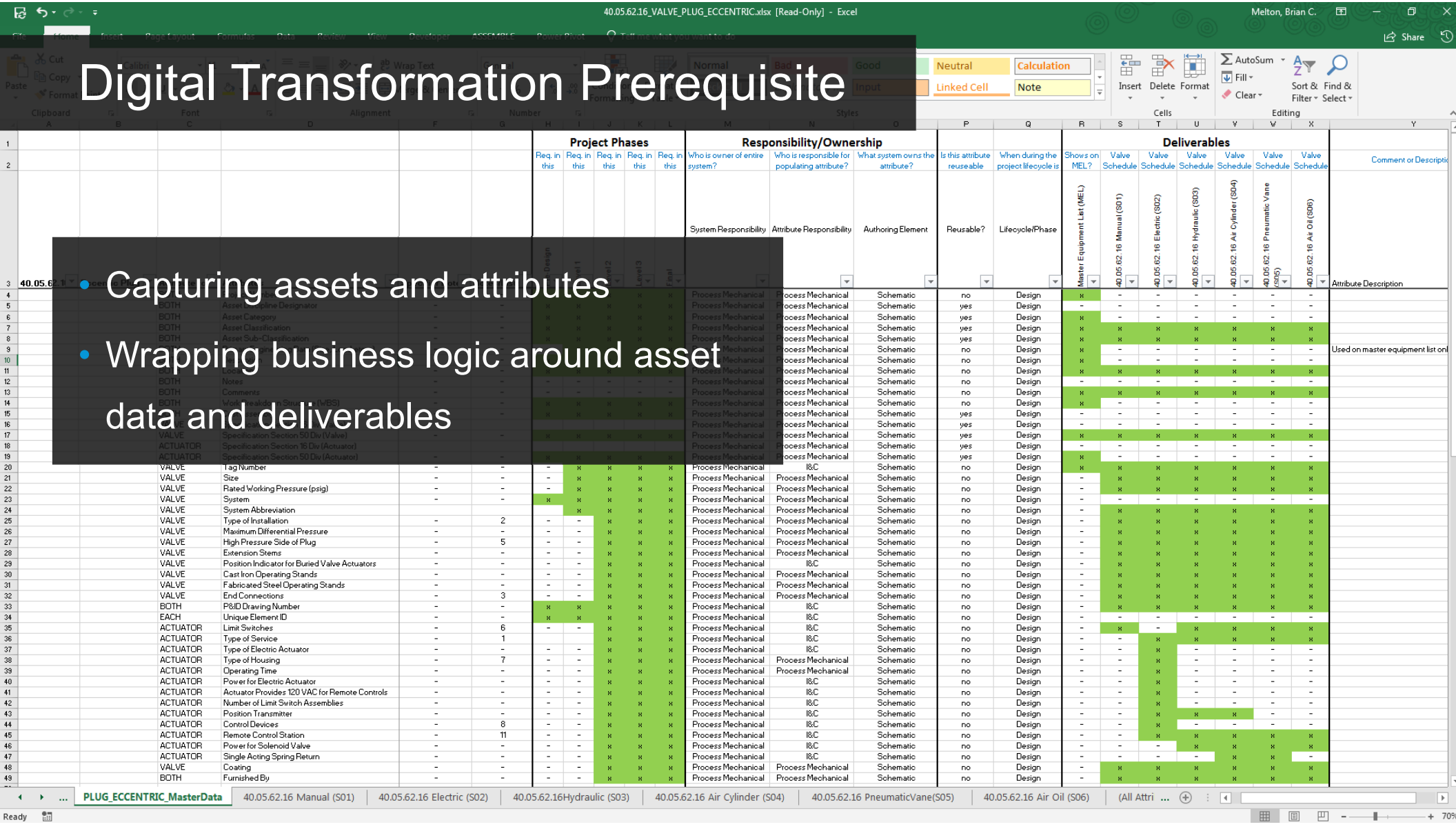


- What do we design?
- What do we need to know?
- When do you need it?
- Who is responsible for it?
- Where does it go?
- What is it used for?

Estimated 30% of all data about an asset is reusable across projects.

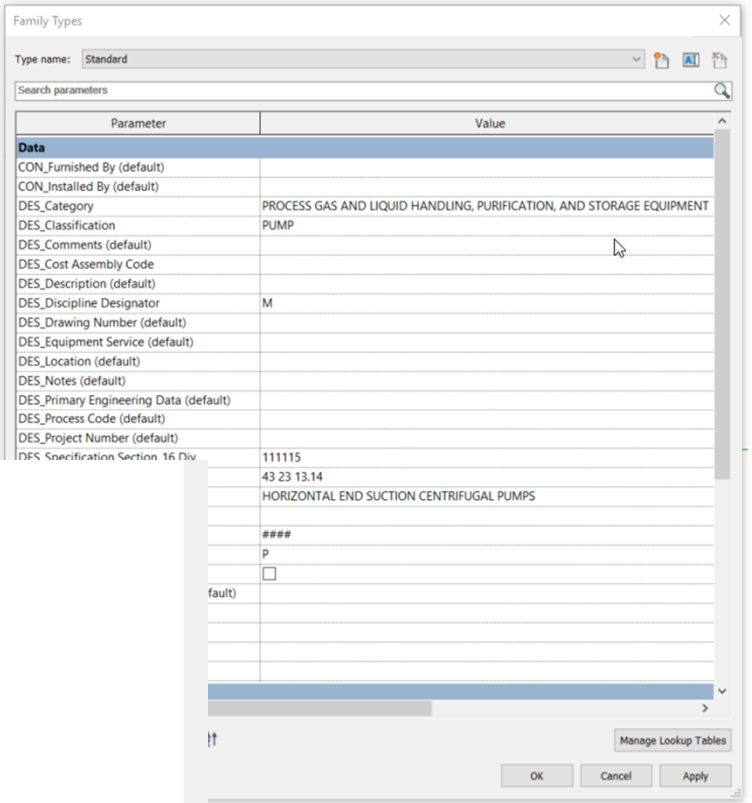
Digital Transformation Prerequisite

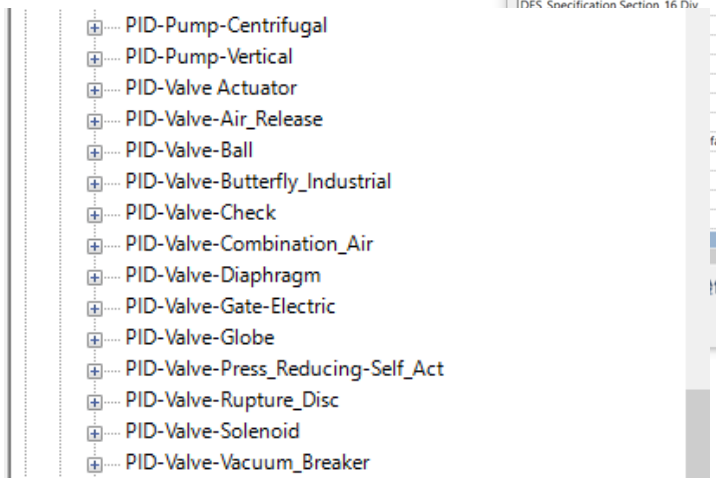
- Capturing assets and attributes
- Wrapping business logic around asset data and deliverables

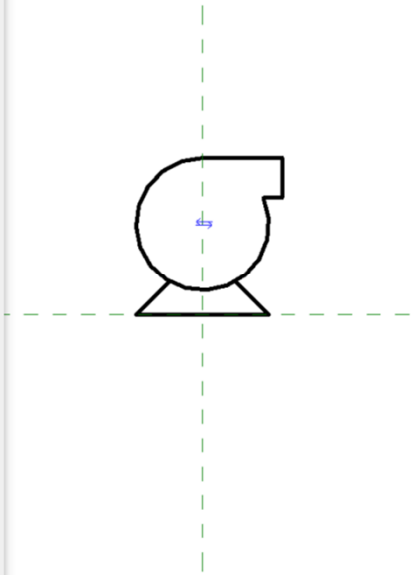


What did we do in Revit | Content

- All schematic elements created using “Detail Item” family category
- Detail Item for each asset class
- 2D objects with attribution built into family



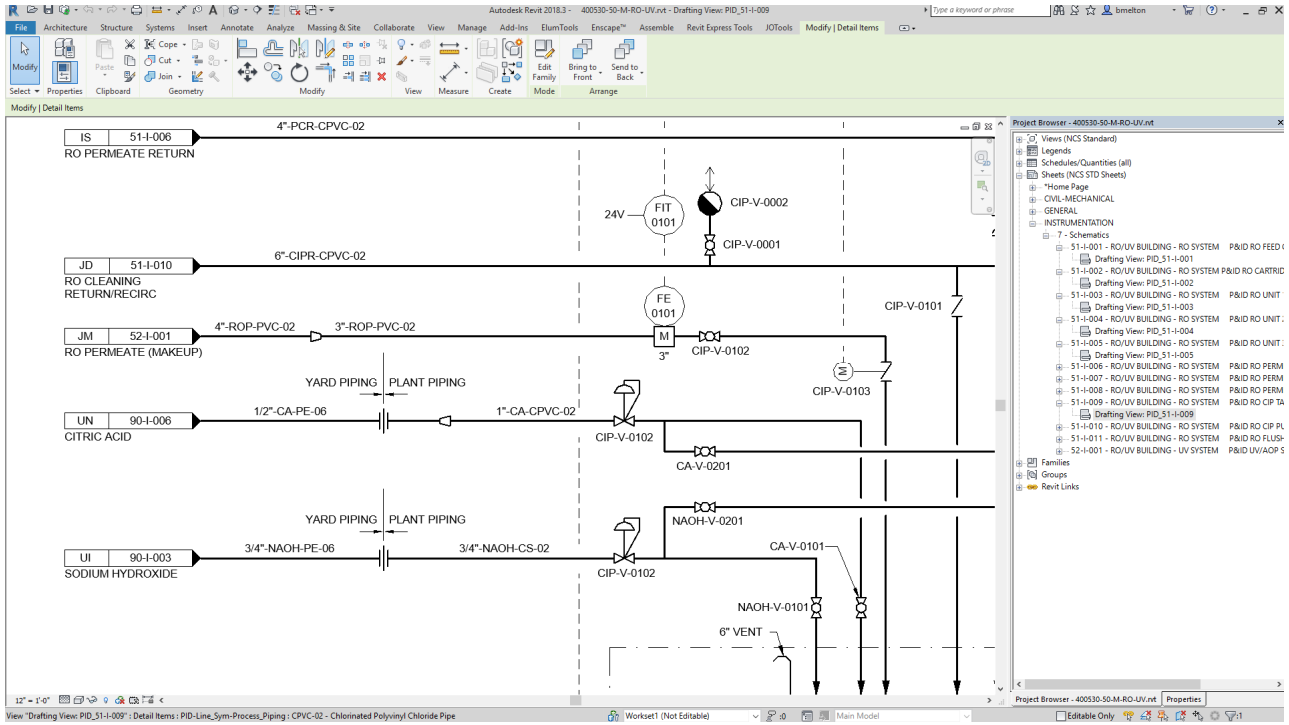




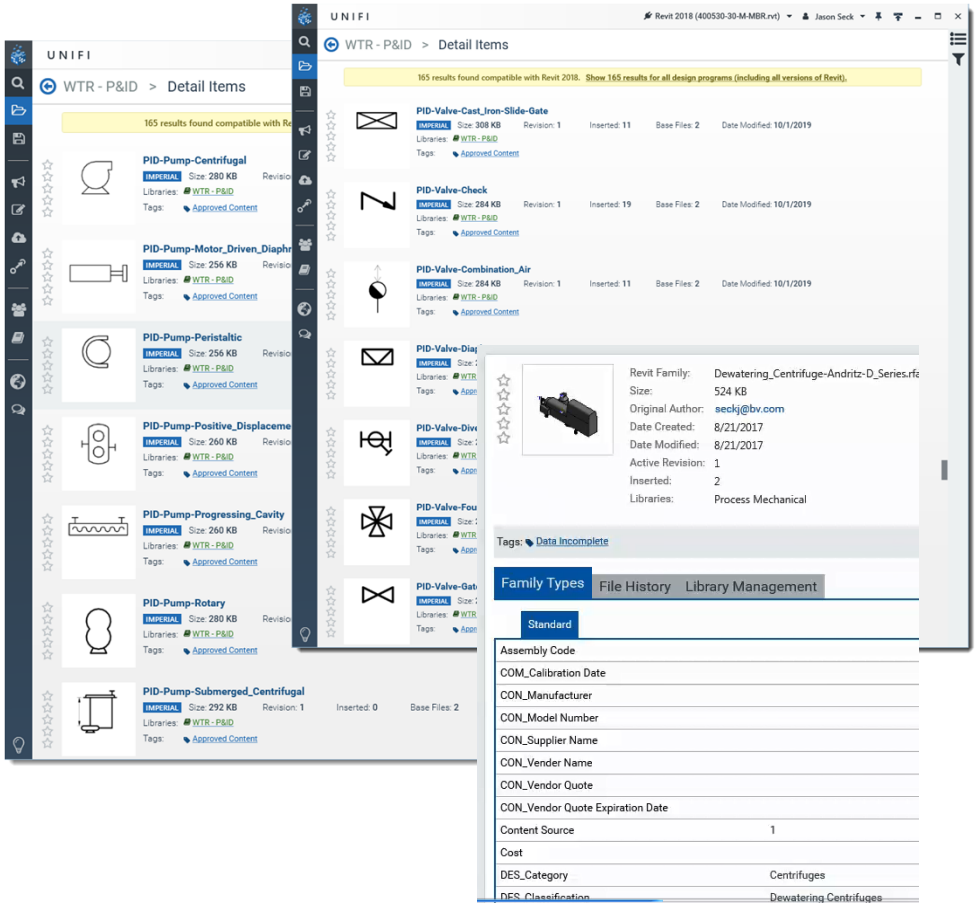
What did we do in Revit | Workflow

AUTODESK® REVIT®

- One drafting view for each P&ID drawing
- P&IDs created in same model as 3D spatial model
- Revit callout tags for drawing
- Workshare-enabled hosted on BIM 360
- Global professionals working on P&IDs

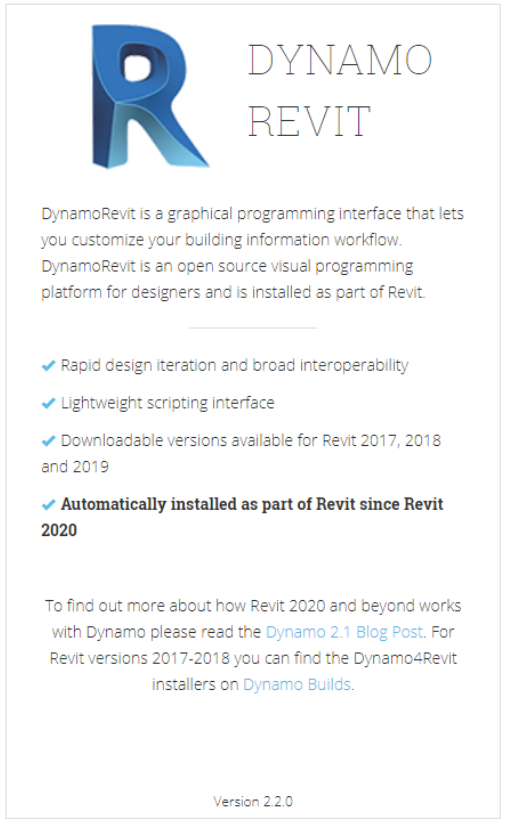


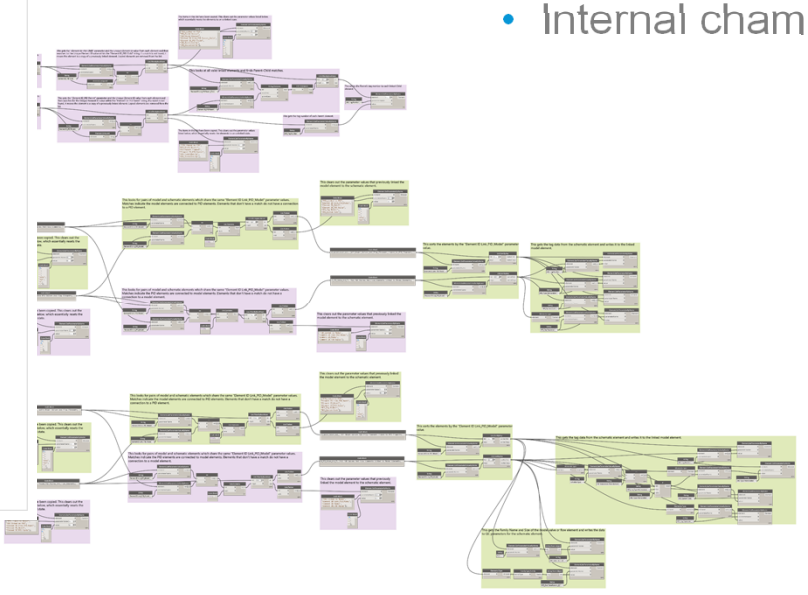
Digital Content Warehouse



- Digital Asset Warehouse available for all to search
- Targeting 30% pre-populated data on all digital assets
- Consolidate 3D & 2D library
- Helping increase quality and efficiency
- Can store typical assemblies and layouts for drafting views

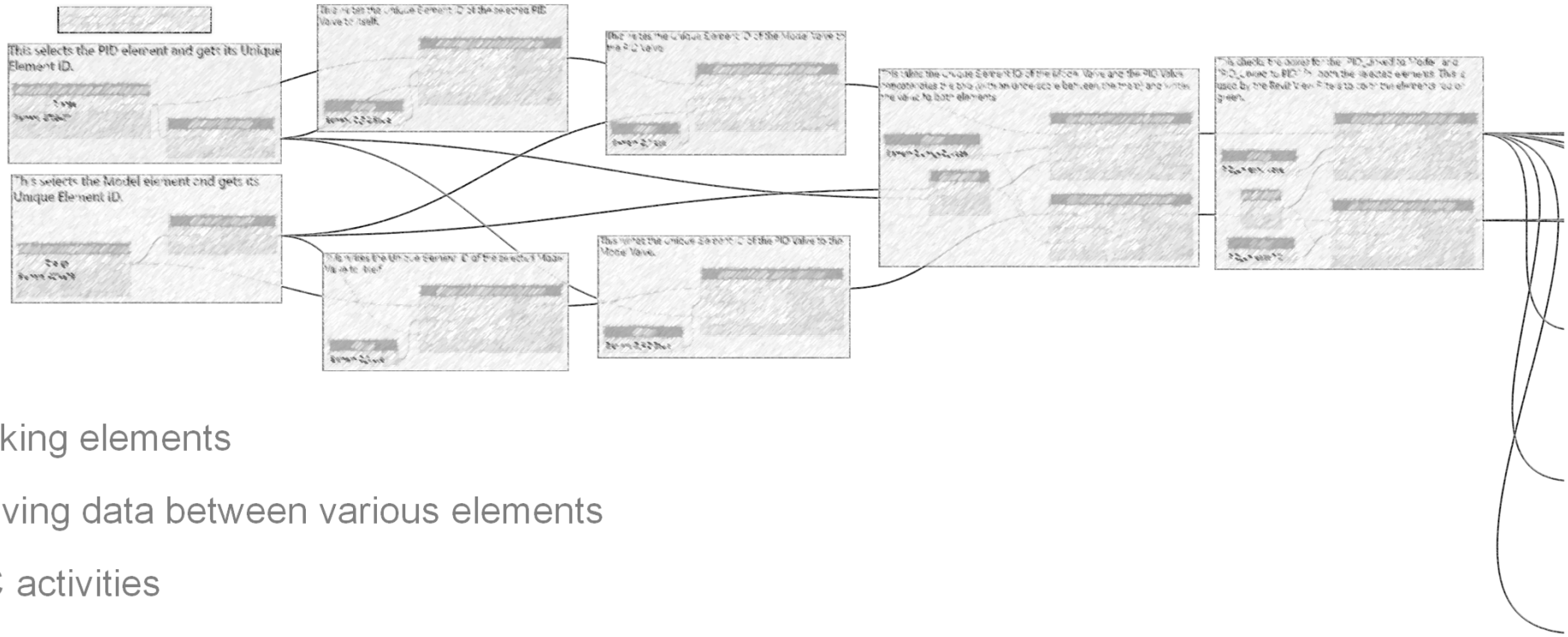
Have you heard of: Dynamo





- Visual programming service to automate, customize and extend capabilities
- DynamoRevit installed as part of Revit
- Internal champion learned on-the-fly

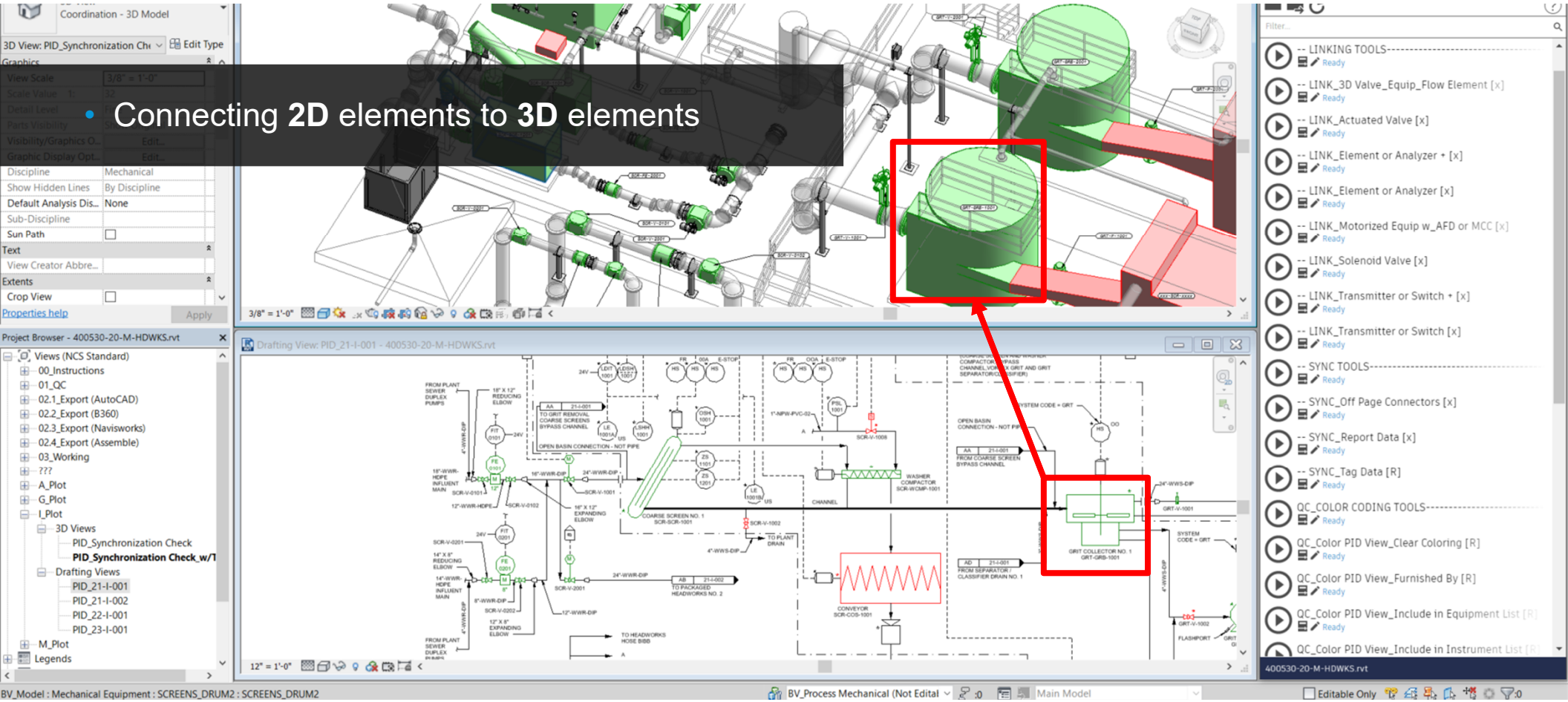
What did we do with Dynamo



- Linking elements
- Moving data between various elements
- QC activities

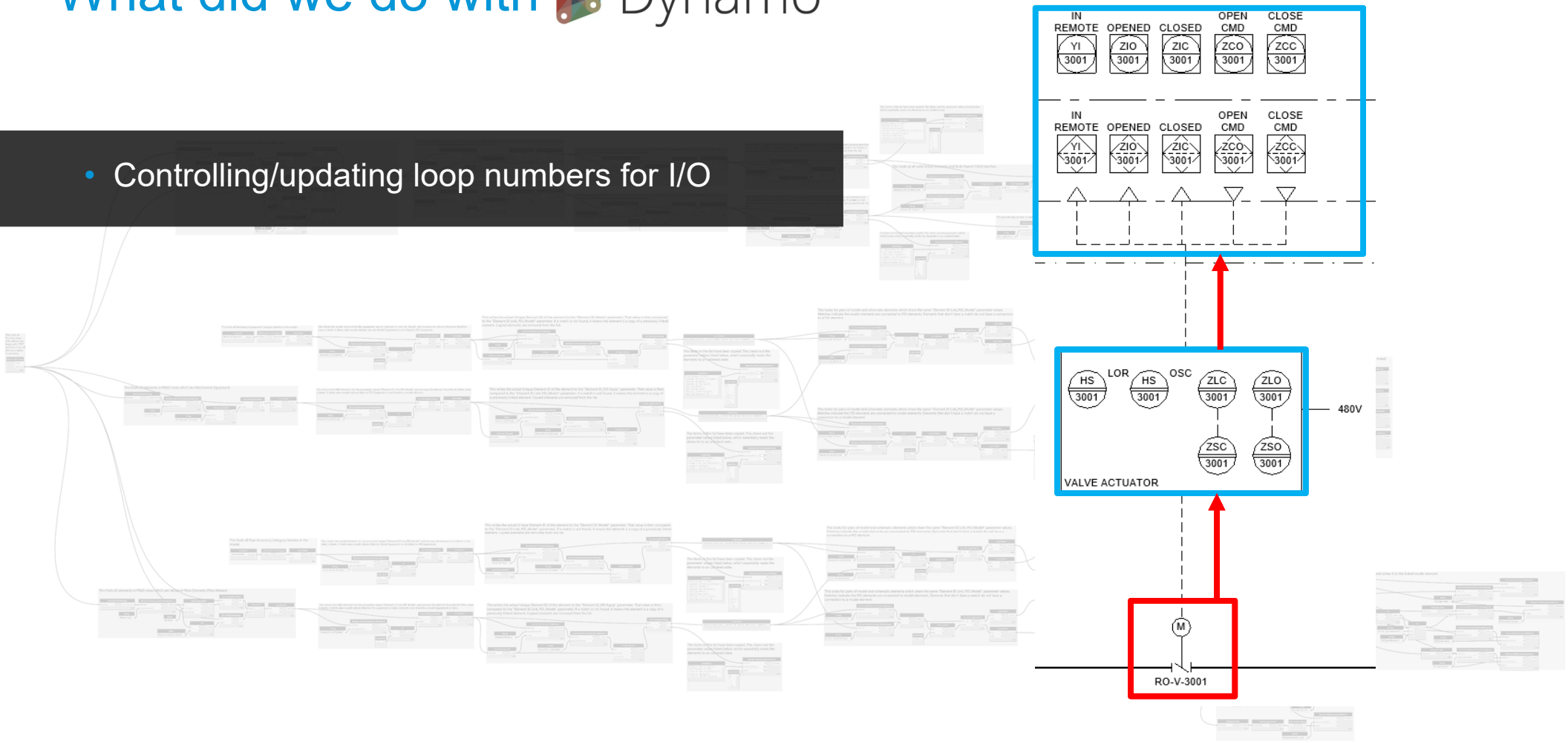
What did we do with Dynamo

- Connecting **2D** elements to **3D** elements



What did we do with Dynamo

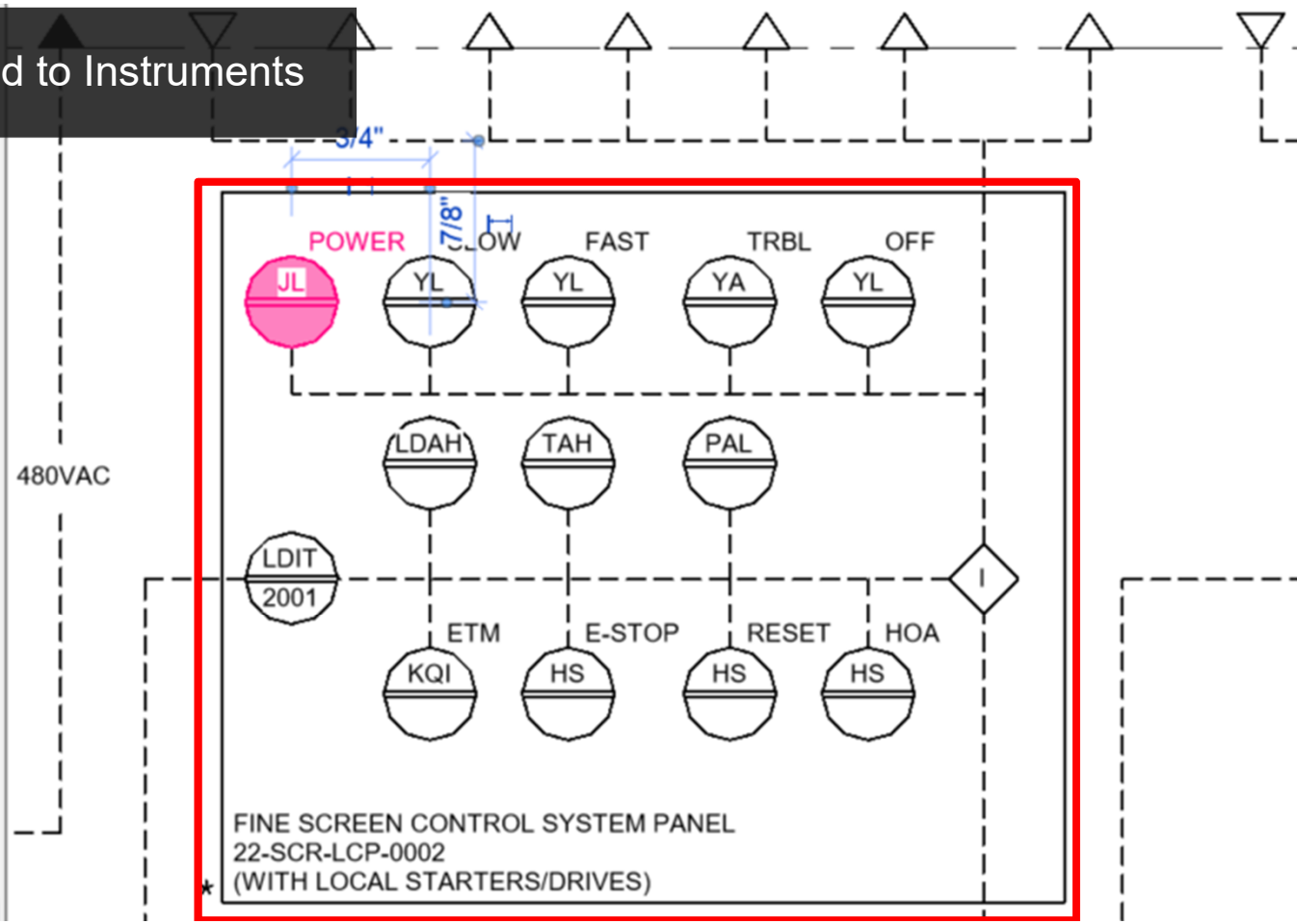
- Controlling/updating loop numbers for I/O



What did we do with Dynamo

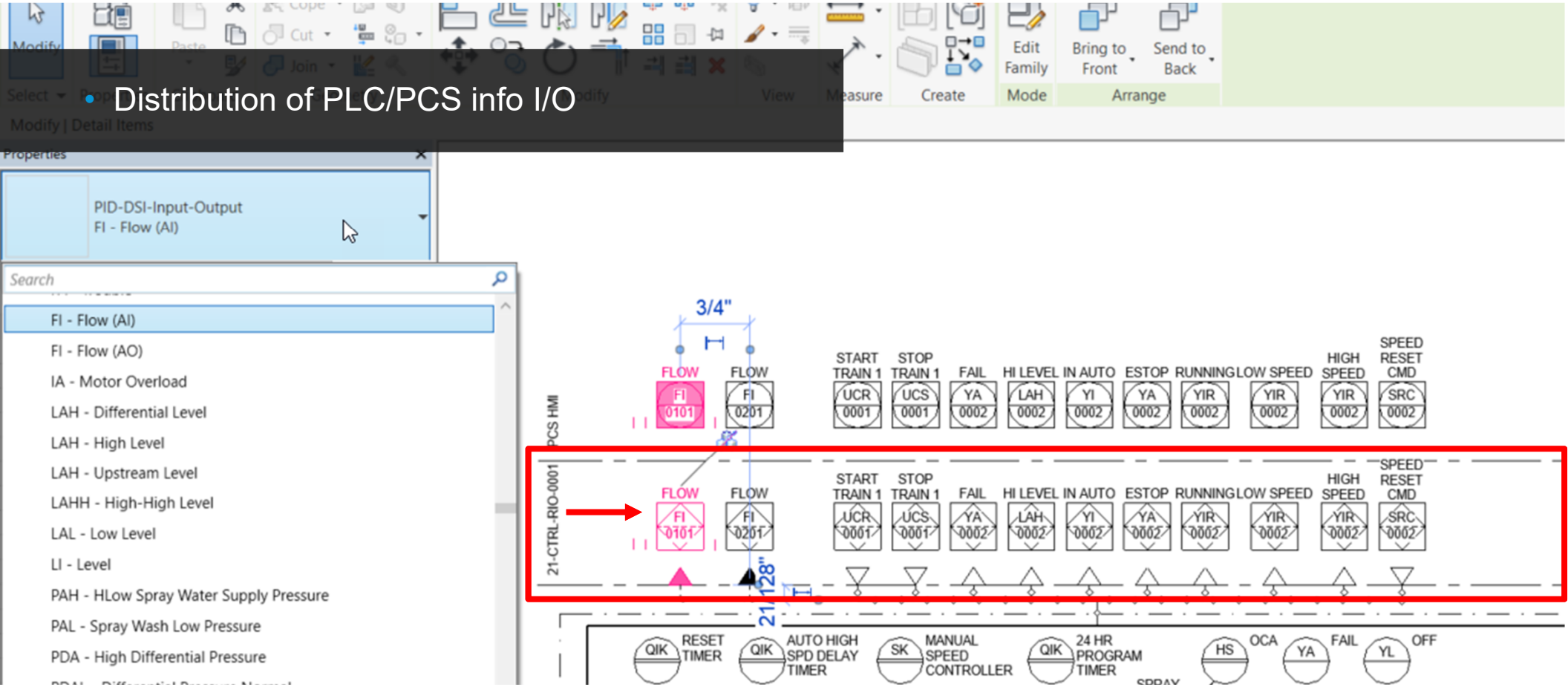
- Local Control Panel data pushed to Instruments

CON_Furnished By	PACKAGED FINE SCREENS SUPPLIER
CON_Installed By	DESIGN-BUILDER
DES_Equipment Description	
DES_Inst_Function	POWER
DES_Inst_Item Number	0
DES_Inst_Location	22-SCR-LCP-0002
DES_Inst_Meas Principle	
DES_Inst_Output Range	N/A
DES_Inst_PG_Medium	
DES_Inst_PG_Mounting	
DES_Inst_PG_Range	
DES_Inst_PG_Service	
DES_Inst_PG_Special Reqs	
DES_Inst_PG_Stem Location	
DES_Inst_PG_Type	
DES_Inst_PG_Units	
DES_Inst_PG_kPa	
DES_Inst_Service Description	
DES_Inst_Size	
DES_Inst_System Code	
DES_Inst_Voltage	
DES_Location	22
DES_Process Code	



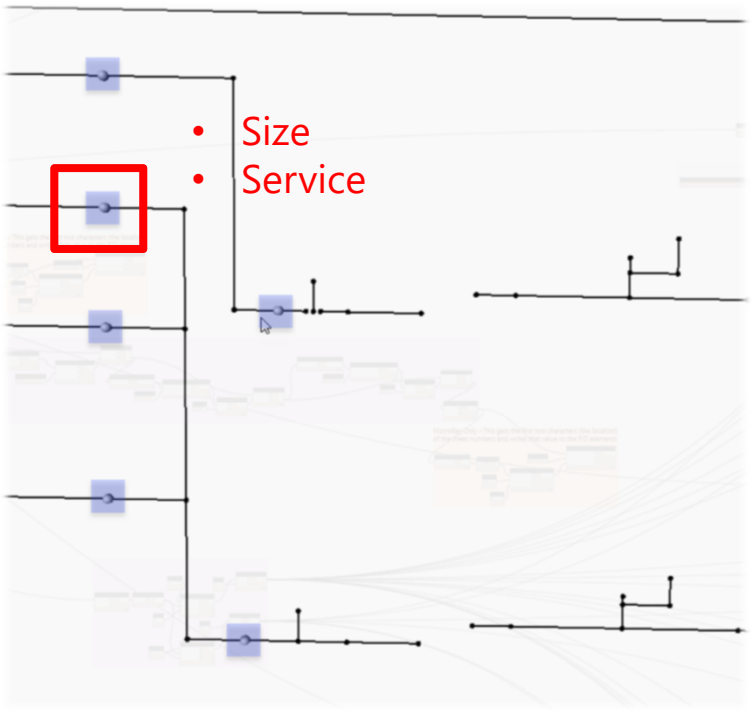
What did we do with Dynamo

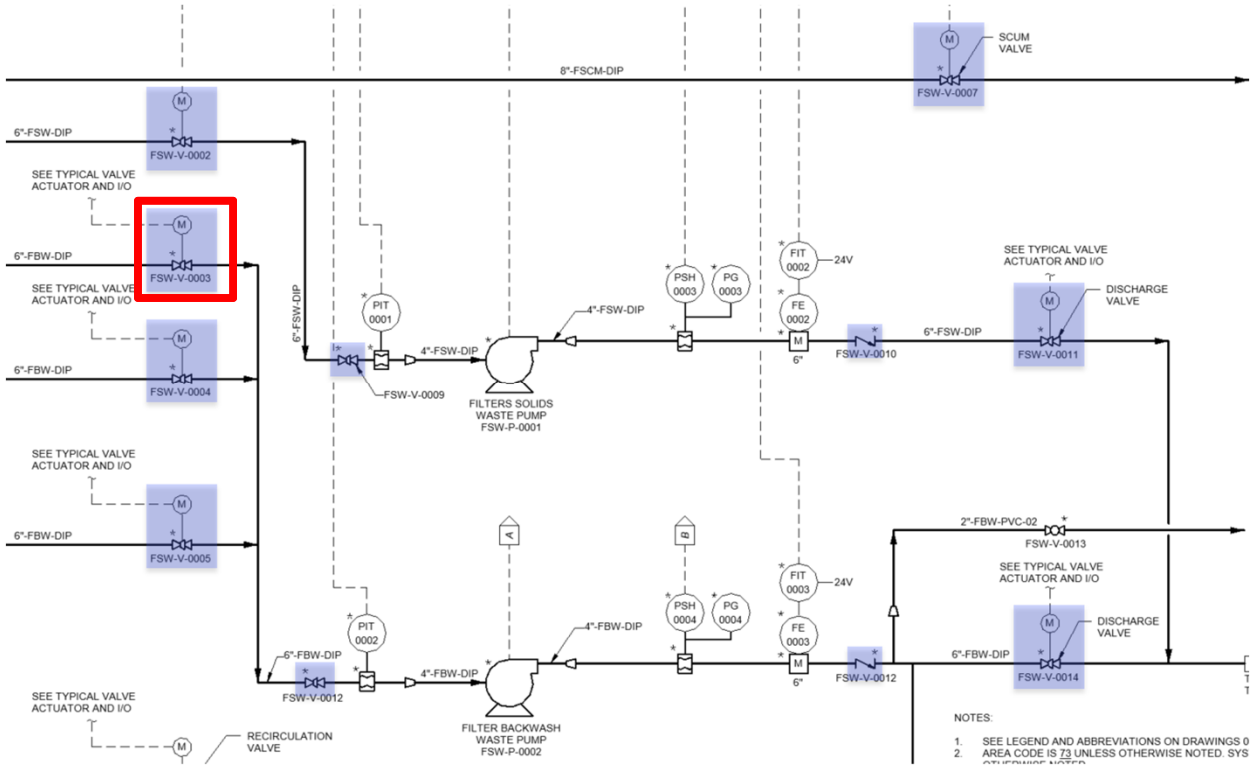
- Distribution of PLC/PCS info I/O



What did we do with Dynamo

- Pipe data distributed to in-line equipment



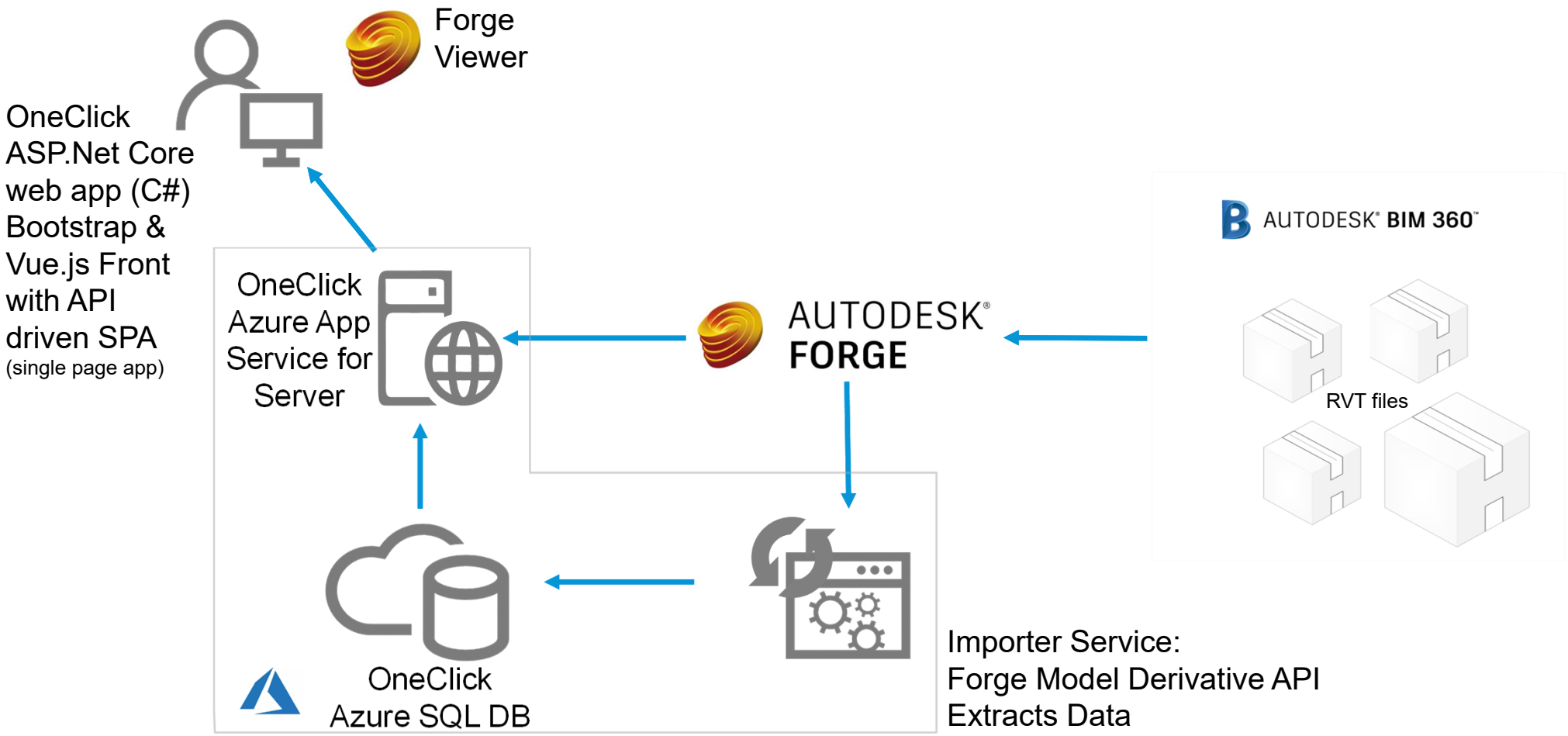


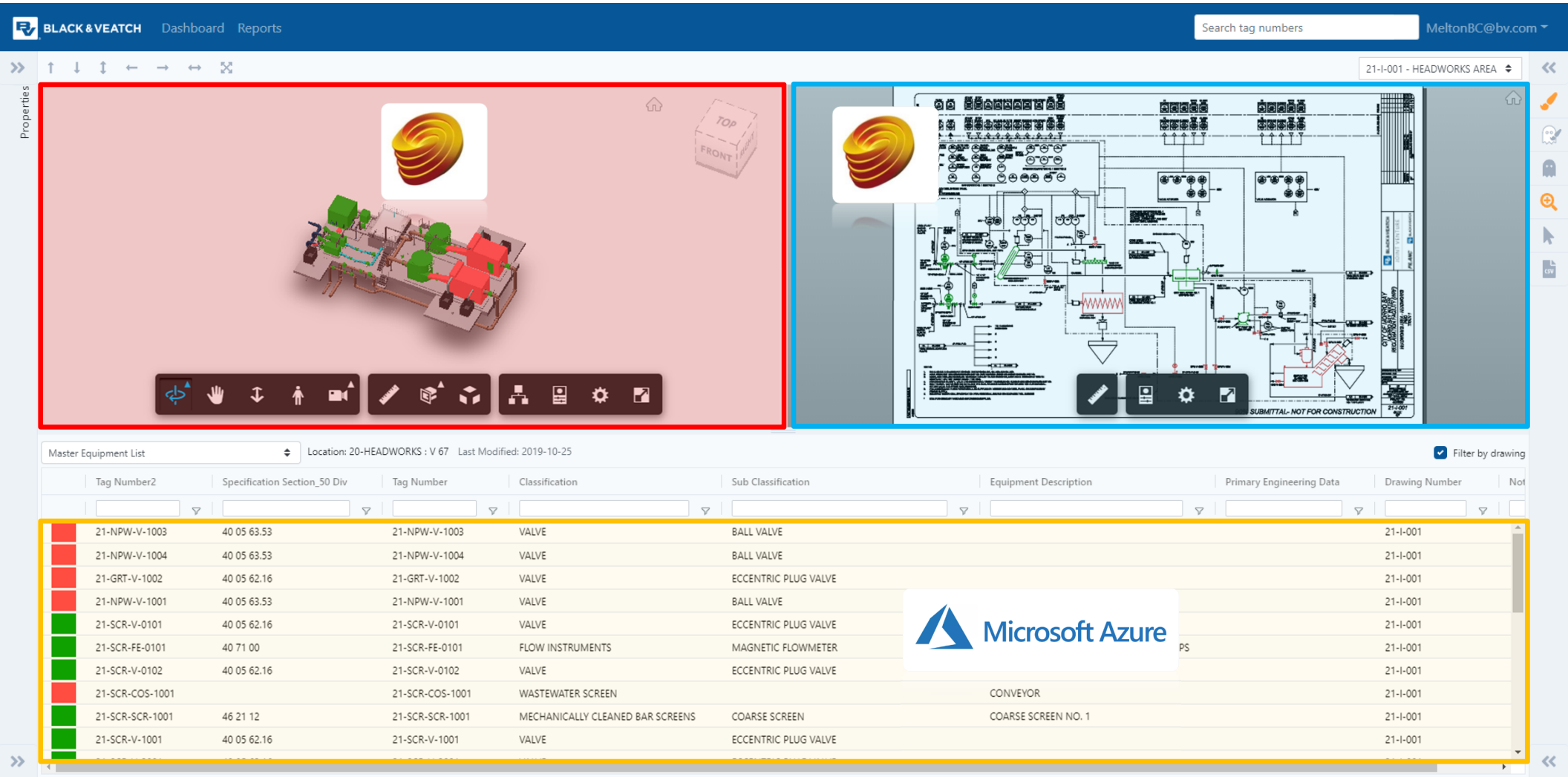
What did we do with:

AUTODESK® FORGE

AUTODESK® BIM 360™

Microsoft Azure




BLACK & VEATCH
Dashboard
Reports
Search tag numbers
MeltonBC@bv.com
21-I-001 - HEADWORKS AREA
Properties
TOP
FRONT
SUBMITTAL- NOT FOR CONSTRUCTION
Master Equipment List
Location: 20-HEADWORKS : V 67
Last Modified: 2019-10-25
Filter by drawing
Tag Number2
Specification Section_50 Div
Tag Number
Classification
Sub Classification
Equipment Description
Primary Engineering Data
Drawing Number
21-NPW-V-1003 40 05 63.53 21-NPW-V-1003 VALVE BALL VALVE 21-I-001
21-NPW-V-1004 40 05 63.53 21-NPW-V-1004 VALVE BALL VALVE 21-I-001
21-GRT-V-1002 40 05 62.16 21-GRT-V-1002 VALVE ECCENTRIC PLUG VALVE 21-I-001
21-NPW-V-1001 40 05 63.53 21-NPW-V-1001 VALVE BALL VALVE 21-I-001
21-SCR-V-0101 40 05 62.16 21-SCR-V-0101 VALVE ECCENTRIC PLUG VALVE 21-I-001
21-SCR-FE-0101 40 71 00 21-SCR-FE-0101 FLOW INSTRUMENTS MAGNETIC FLOWMETER 21-I-001
21-SCR-V-0102 40 05 62.16 21-SCR-V-0102 VALVE ECCENTRIC PLUG VALVE 21-I-001
21-SCR-COS-1001 21-SCR-COS-1001 WASTEWATER SCREEN CONVEYOR 21-I-001
21-SCR-SCR-1001 46 21 12 21-SCR-SCR-1001 MECHANICALLY CLEANED BAR SCREENS COARSE SCREEN COARSE SCREEN NO. 1 21-I-001
21-SCR-V-1001 40 05 62.16 21-SCR-V-1001 VALVE ECCENTRIC PLUG VALVE 21-I-001
Microsoft Azure

Near-term updates

- Electrical
- Linking @ web level
- Edit data @ web browser
- Evaluating Dynamo vs. Revit API
- Flexibility to use alternate P&ID apps

Lessons Learned

- Understanding how a true data-centric process impacted our workflow
- Forge Updates: Model derivative API failed to query data, Autodesk added options to force a retry programmatically
- Viewer side Forge API, challenged us more than others.
- Easy things in schematic apps proved to be difficult in Revit schematics:
  - Multi-line segments
  - Line breaks are manual
  - Offpage connectors

Feedback from Project Team

"This approach eliminated several manual steps where I would have traditionally worked in excel and/or pdf files. Using data to color P&IDs in the web browser helped with QC."

Brian Butler

- Kansas City, MO
- Lead I&C Engineer

"Working with the data in Revit was a time-saver and having access to the data in the web browser reduced my time looking for information. I had more confidence in a synchronized design with our digital QC efforts"

Kaitie Zusy

- Walnut Creek, CA
- Lead Civil/Process Engineer

"Creating P&IDs in Revit was similar experience to creating in ACAD P&ID… more comfortable using several automated features in Revit to speed up work and reduce chance for errors"

Priya Rane

- Mumbai, India
- I&C Technician

Value

100%	?	?	?
IMPROVEMENT IN USER EXPERIENCE	REDUCTION IN SEARCHING	REDUCTION IN QC TIME	MITIGATING ERRORS & OMISSIONS
Improved Team Experience	Time required to locate data	Time required for QC	Mitigating chances of errors and omissions

Order of Magnitude #’s

How to Get More Involved

Activities/Events

- Autodesk Hosted Industry Water Council

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