

Facilities of the future: Developing & Integrating Facility Digital Twins using Forge

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- Design | Research | BIM-FM
- Subject Matter Expert: Healthcare Facilities Management
- BIM/VDC Engineer, DPR Construction
- MA Architecture, PhD Construction Engineering & Management, Arizona State University



VueOps

Design/Engineering/Construction

Owner Operations

Learning Objectives

1. What is the definition of a Facility Digital Twin?
2. What are the challenges in getting there?
3. How the Autodesk Forge platform supports the vision?
4. How can you get started?

Agenda

- Better Outcomes for Facility Operations & Maintenance
- Digital Twins: Why, What, How, and the Challenges
- VueOps Case Studies: How do you get there?
- VueOps' Journey towards the Facility Digital Twin

Facility Digital Twins



Digital twin refers to a digital replica of potential and actual physical assets (physical twin), processes, people, places, systems and devices that can be used for various purposes.

The digital representation provides both the elements and the dynamics of how an Internet of things device operates and lives throughout its life cycle

Wikipedia

CapEx

*Improve ROI by extending
equipment service life*

OpEx

*Reduce operations &
maintenance costs through
faster response times*

CapEx

OpEx

CapEx

OpEx

Challenges

Maintenance and Operations

- Fewer and fewer maintenance staff to cover more and more square footage
- Increased pressure to fix emergencies faster
- Back log of PM's and lack visibility into state of many tasks
- Either don't have systems or have systems that people don't use (consistently)
- Time = 20% Proactive – 80% Reactive
- Huge unbudgeted burden to bring on a new building/project and align it with existing systems and processes

Challenges

Transition from Capital to Operations

- Existing Systems Need to Be Updated with Information Provided At Construction Turn Over
 - No Integration Plan or Clear Technical Set of Requirements
 - Document and Service Work Management
- Interest in Using a Construction Model Post Construction
 - Use cases evolving and unproven
 - Different Tools, Incomplete Attributes, Not All Users Native Model Files
- Limited Budgets for Improving Models or Integration
- Building changes after handover

Imagine if you could...



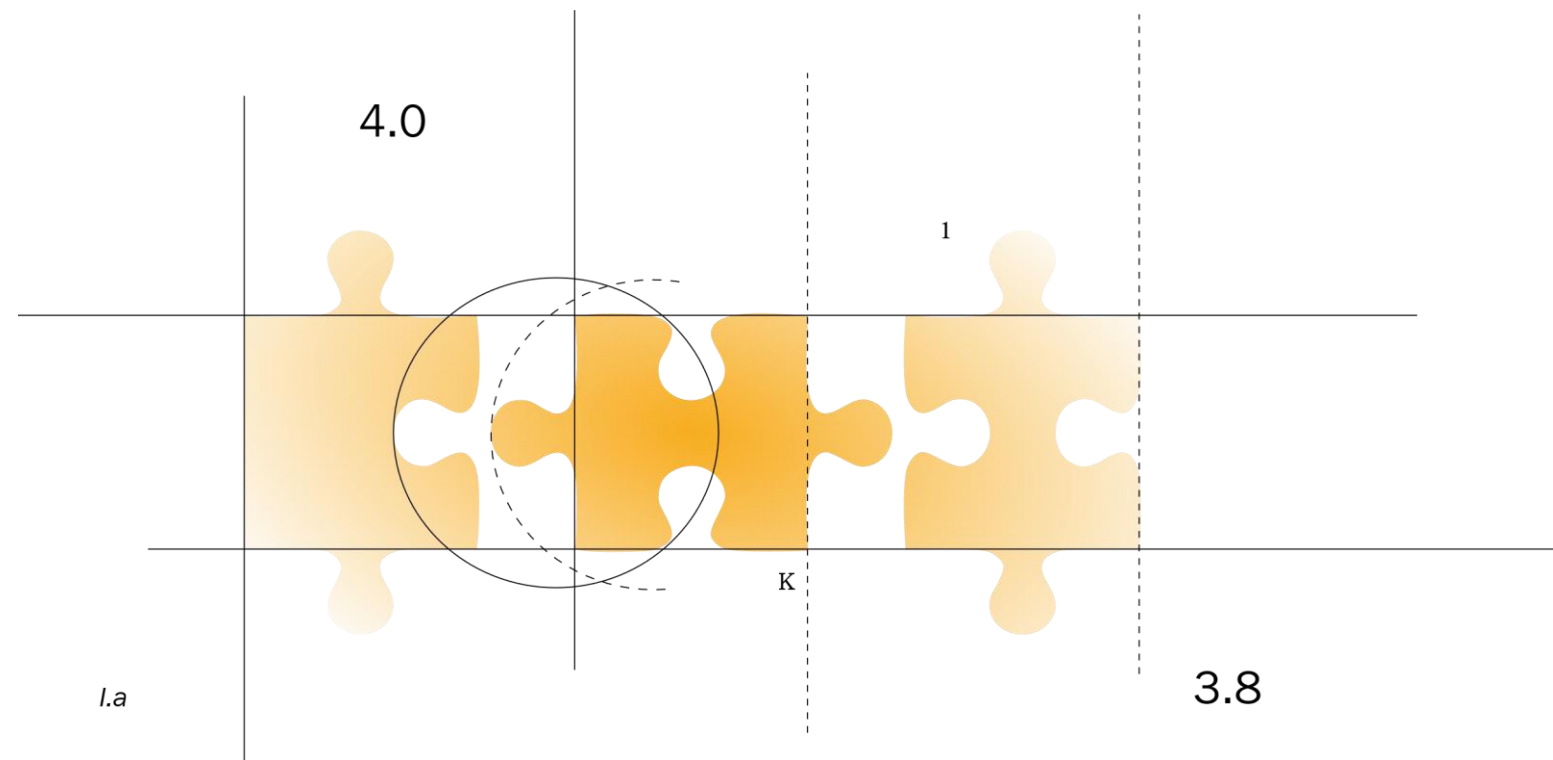
- Digital Twin for Integrated Information
- Web Portal with Building Assets & Data
- BIM for Facility Management
- Manage Warranty & Ticketing

VueOps Case Studies

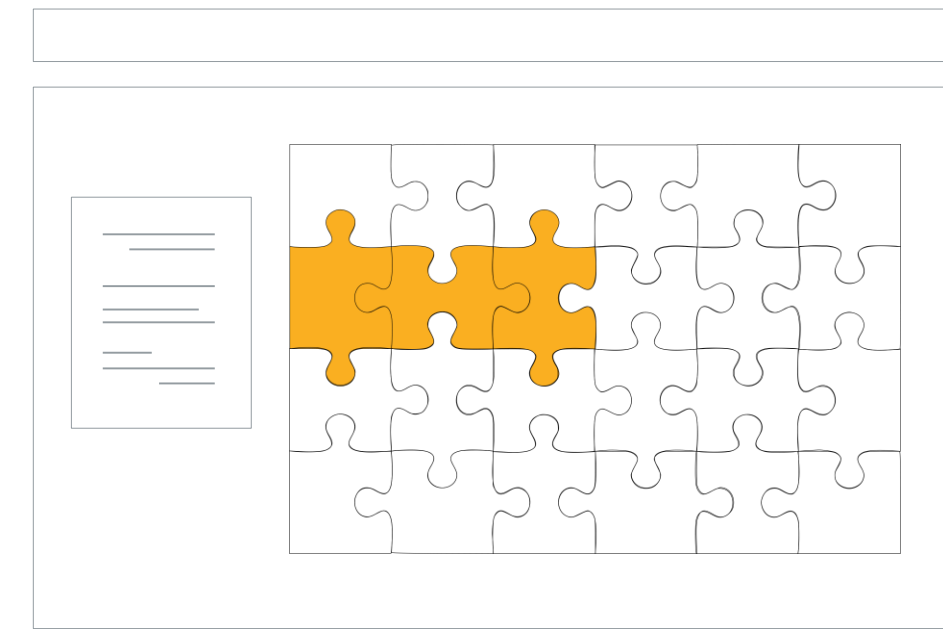
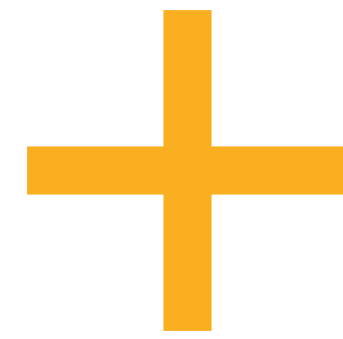


VueOps

Preparing the Digital Twin



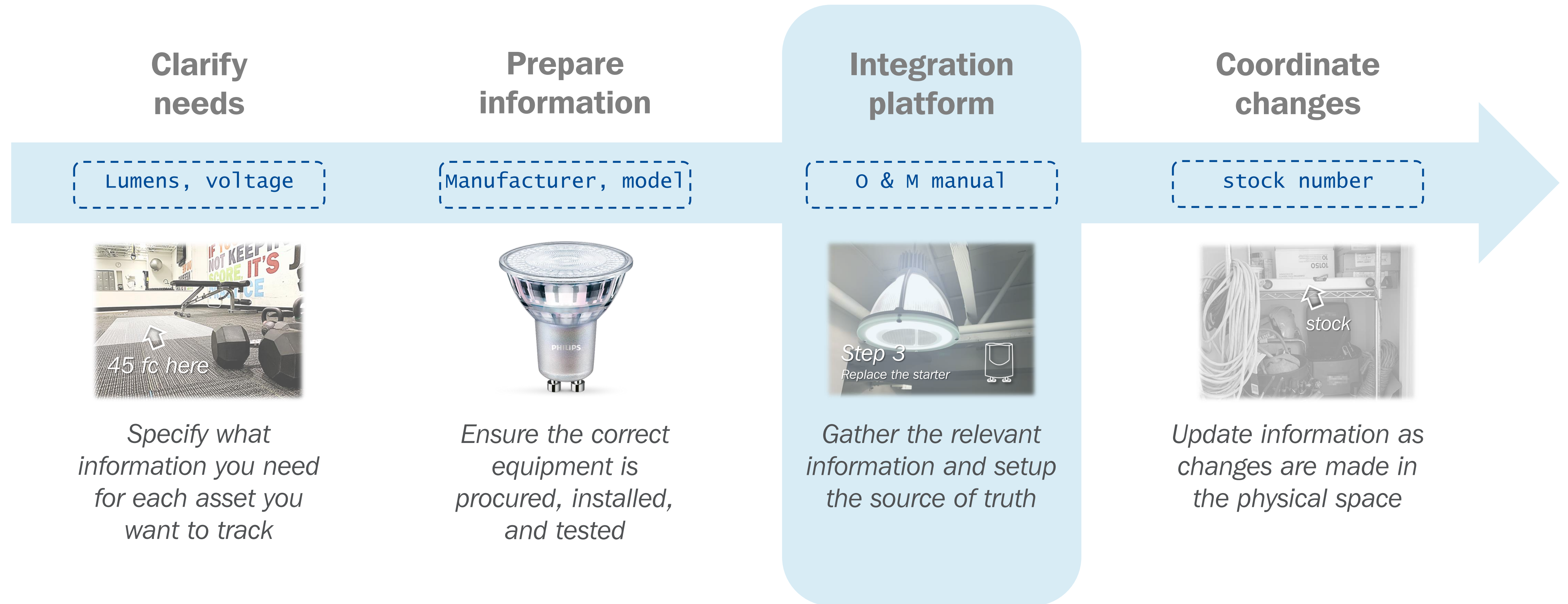
VueOps **method**
to ***prepare*** information
for operations



VueOps **platform**
to ***access*** information
for operations

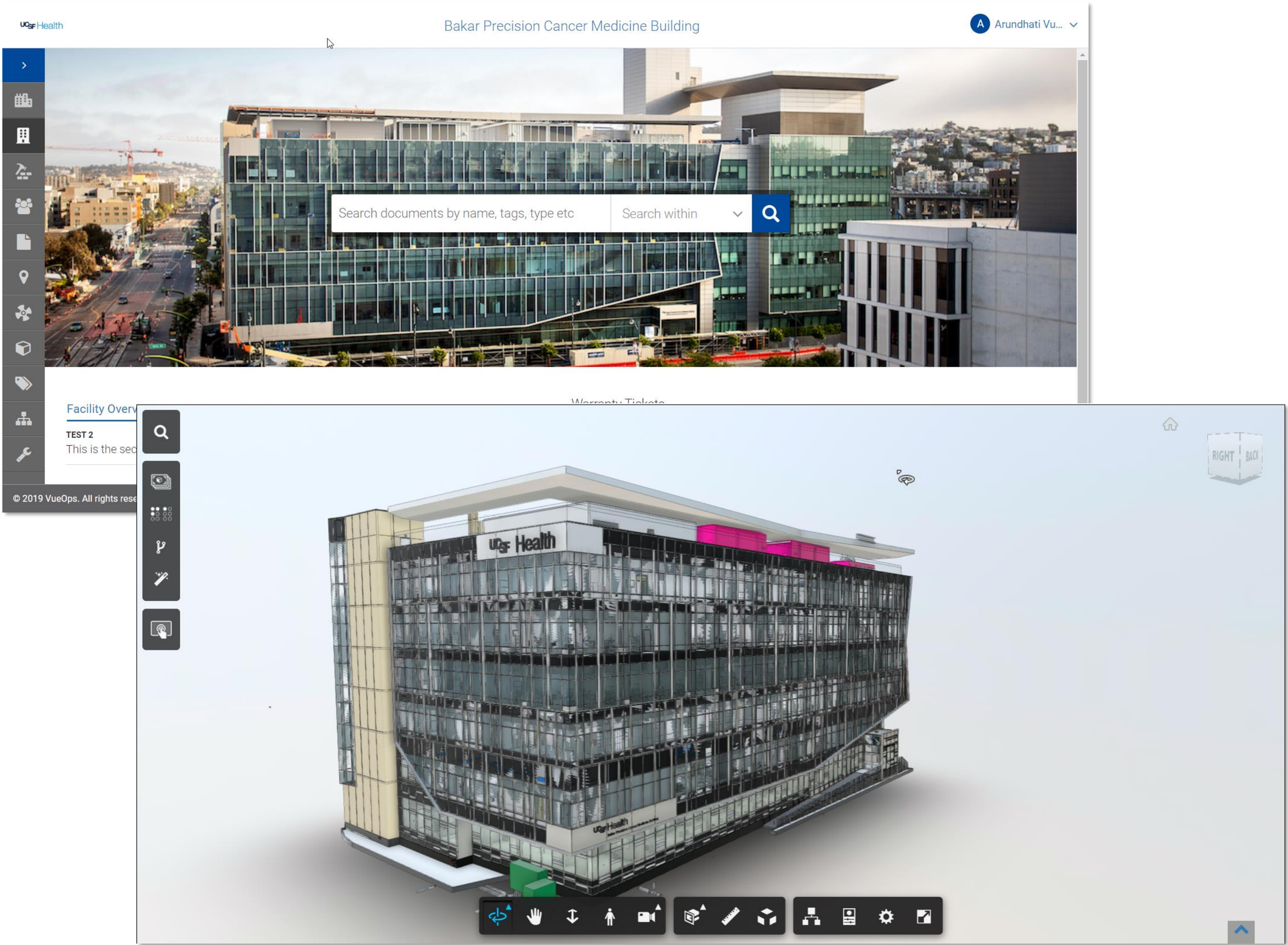
Method

Preparing the Digital Twin



Customer Engagement: Early Start

UCSF Precision Cancer Medicine Building, San Francisco



18

Months of
incremental data
collection and
verification

180K

Square feet

\$275m

Project cost

189

Asset types

5,265

Total assets

262

Attribute types

UCSF Health

RUDOLPH AND SLETTEN

VueOps™

Customer Engagement: Early Start

UCSF Precision Cancer Medicine Building, San Francisco

Decisions

- Where to collect the data – in the model or outside the model?
- Record model or As-Built model?
- Who models and who collects the data: Design Engineer or Contractor?
- I don't want someone else's data in my models!
- When should we collect the data?
- Build what you model or Model what you build?
- What is the final format for the data?
- What happens post-construction?



Customer Engagement: Late Start

Lifesciences Real Estate Developer, Southern California



Months of one-time data collection at the end of project

Square feet

Project cost



Asset types

Total assets

Attribute types

Confidential client



Customer Engagement: Late Start

Lifesciences Real Estate Developer, Southern California



VueOps™

Decisions

- What data is available in the models?
- Where can we find the missing data – approved submittals, procurement logs, record set
- Is the data true?
- Scope gaps – Who will model the gaps?

Defining better data requirements

ASSET LIST: Help a project team understand what assets an owner cares about managing

ATTRIBUTES: What data does the owner care for?

VueOps

D10 Conveying

D20 Plumbing

D30 HVAC

D40 Fire Prote...

D50 Electrical

E10 Equipment

B30 Exterior H...

C10 Interior Co...

What assets are in the project?

Are they modeled?

Who is responsible for authoring the products and data?

Is the asset uniquely represented?

1. Data Requirement

Maximo Asset

Visualization Only

In Project? [Yes/No]

NO

YES

3. Is Product Modeled?

(blank)

YES

TBD

NO

4. Which Trade Model?

PCMB-E.rvt

PCMB-EQ.rvt

PCMB-FP.dwg

PCMB-M.rvt

(blank)

5. Is Product Tagged?

NO

YES

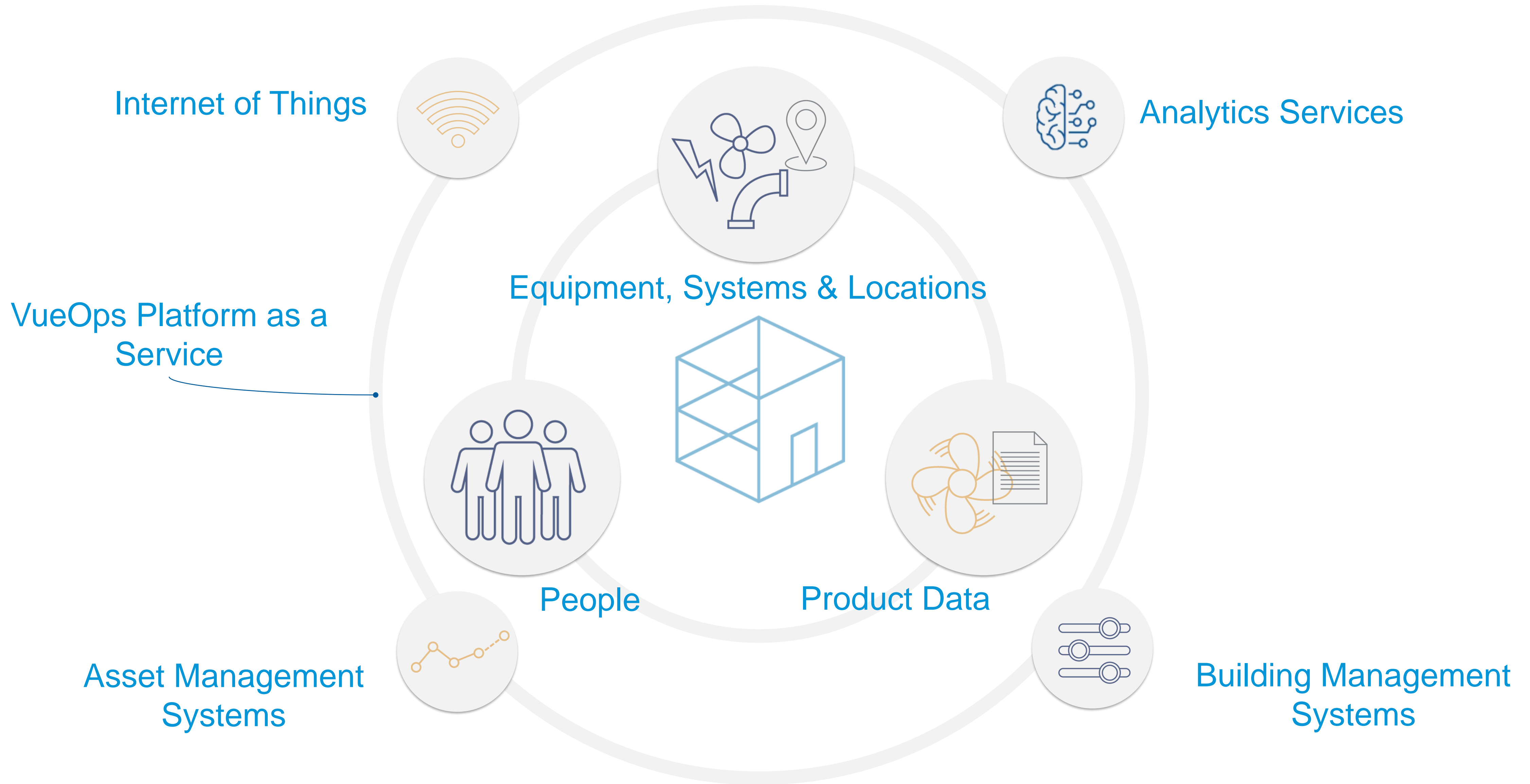
(blank)

Product Class [OmniClass Level 2 Number: Name]	OmniClass [OmniClass Level 3/4 Number]	Product [OmniClass Level 3/4 Name]	Attribute Sets	Tag Abbreviat
23-33 11 00: Commercial Boilers	23-33 11 00	Commercial Boilers	(blank)	BLR
	23-33 11 13	Condensing Boilers	(blank)	BLR
	23-33 11 17	Flexible Tube Boilers	(blank)	BLR
	23-33 11 21	Water Tube Boilers	(blank)	BLR
	23-33 11 22	Electric Boilers	(blank)	BLR
23-33 15 00: HVAC Heating Units	23-33 15 21	Hydronic HVAC Heaters	(blank)	HHWC
23-33 21 00: Chillers	23-33 21 13 11	Central Package Unit Chillers	A_COMMON/A_MOTOR/A_CHILLER	CH
		Centrifugal Chillers	A_COMMON/A_MOTOR/A_CHILLER	CH
	23-33 21 13 13	Reciprocating Chillers	A_COMMON/A_MOTOR/A_CHILLER	CH
	23-33 21 13 17	Rotary Chillers	A_COMMON/A_MOTOR/A_CHILLER	CH
	23-33 21 13 19	Rotary Screw Chillers	A_COMMON/A_MOTOR/A_CHILLER	CH
	23-33 21 13 21	Screw Chillers	A_COMMON/A_MOTOR/A_CHILLER	CH
	23-33 21 13 23	Scroll Chillers	A_COMMON/A_MOTOR/A_CHILLER	CH
23-33 23 00: Cooling Towers	23-33 23 11	Mechanical Draft Cooling Towers	A_COMMON/A_MOTOR/A_COOLING-TOWER	CT
	23-33 23 13	Natural Draft Cooling Towers	(blank)	CT
23-33 29 00: HVAC Dampers	23-33 29 19	Dampers	A_COMMON	DMPR
	23-33 29 23	Fire Dampers	A_NOSERIAL	FDMPR
	23-33 29 25	Smoke Dampers	A_COMMON	SDMPR
23-33 31 00: Air Circulators	23-33 31 19	Booster Fan		
		Fans	A_COMMON/A_MOTOR/A_FAN	FN
	23-33 31 21	Power Ventilators (Cooling)	A_COMMON/A_MOTOR/A_HVAC POWER VENTIL	VENT
23-33 37 00: Refrigerant Condensing Units	23-33 37 00	Refrigerant Condensing Units	(blank)	(blank)
23-33 39 00: Air Conditioning Equipment				
23-33 43 00: HVAC Condenser Units				
23-27 17 00: Pumps	23-27 17 00	Fuel-oil pump	(blank)	CP
		Boiler feedwater pump	(blank)	(blank)
		Drainage pump	(blank)	(blank)
		Sanitary sewage pump	(blank)	SP
		Steam condensate pump	A_COMMON/A_MOTOR/A_STEAM CONDENSATE	CP
		Storage tank pump	(blank)	HWTP
		Stormwater drainage pump	(blank)	SD
		Fire pump	A_COMMON	FP
23-27 23 00: Heat Exchangers	23-27 23 00	Heat Exchangers (plumbing)	A_COMMON/A_HEAT-EXCHANGER2	HEX
23-23 23 00: Loading Dock Equipment	23-23 23 00	Loading Dock Equipment	(blank)	(blank)
23-27 21 00: Compressors	23-27 21 00	Air Compressors	A_COMMON/A_MOTOR/A_COMPRESSOR	COMP
23-27 29 00: Tanks and Storage	23-27 29 19	Batchwater storage tanks	(blank)	un

VueOps' Journey towards the Integrated Digital Twin

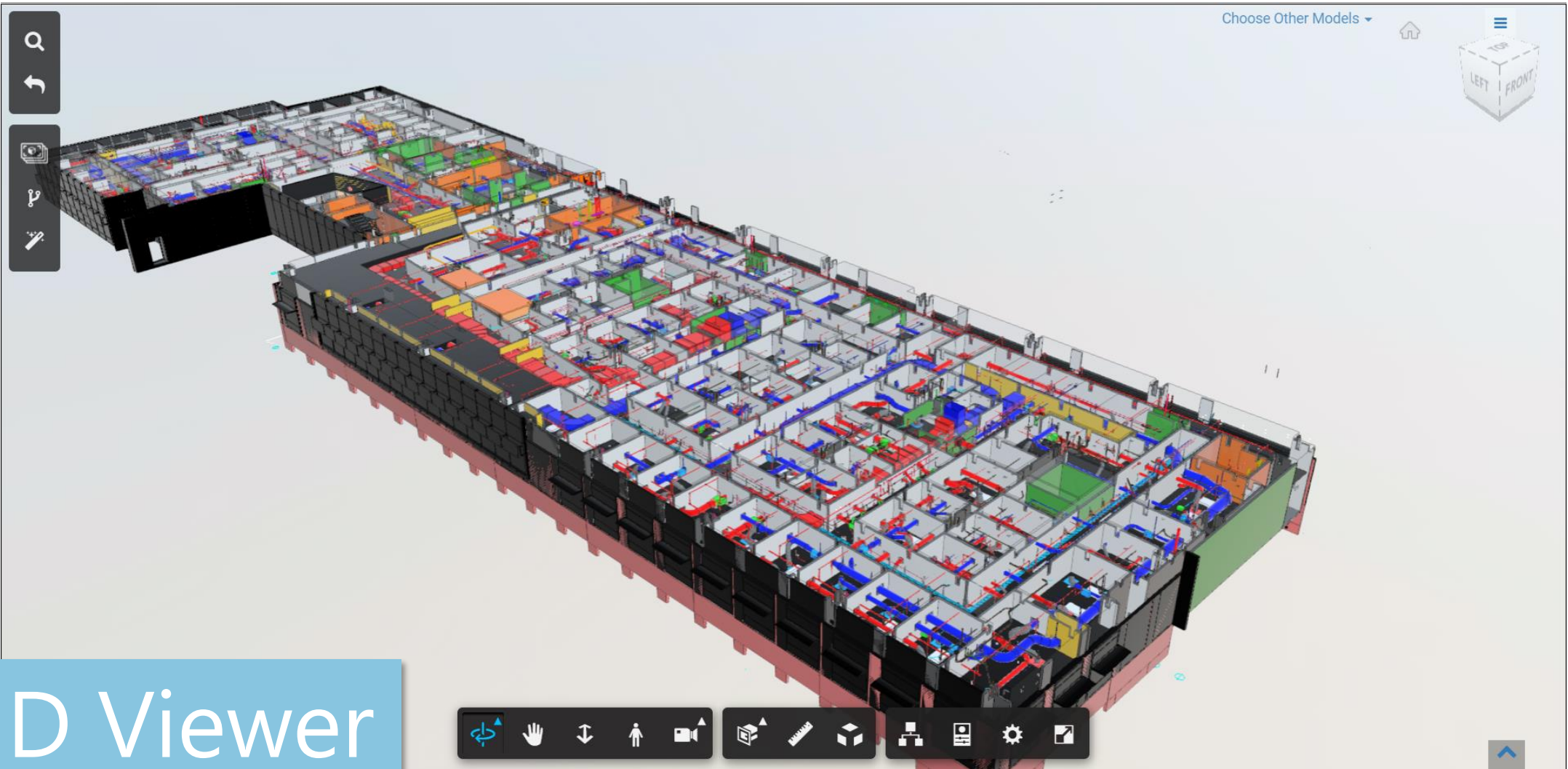


Integrated Platform for Data and Visualization

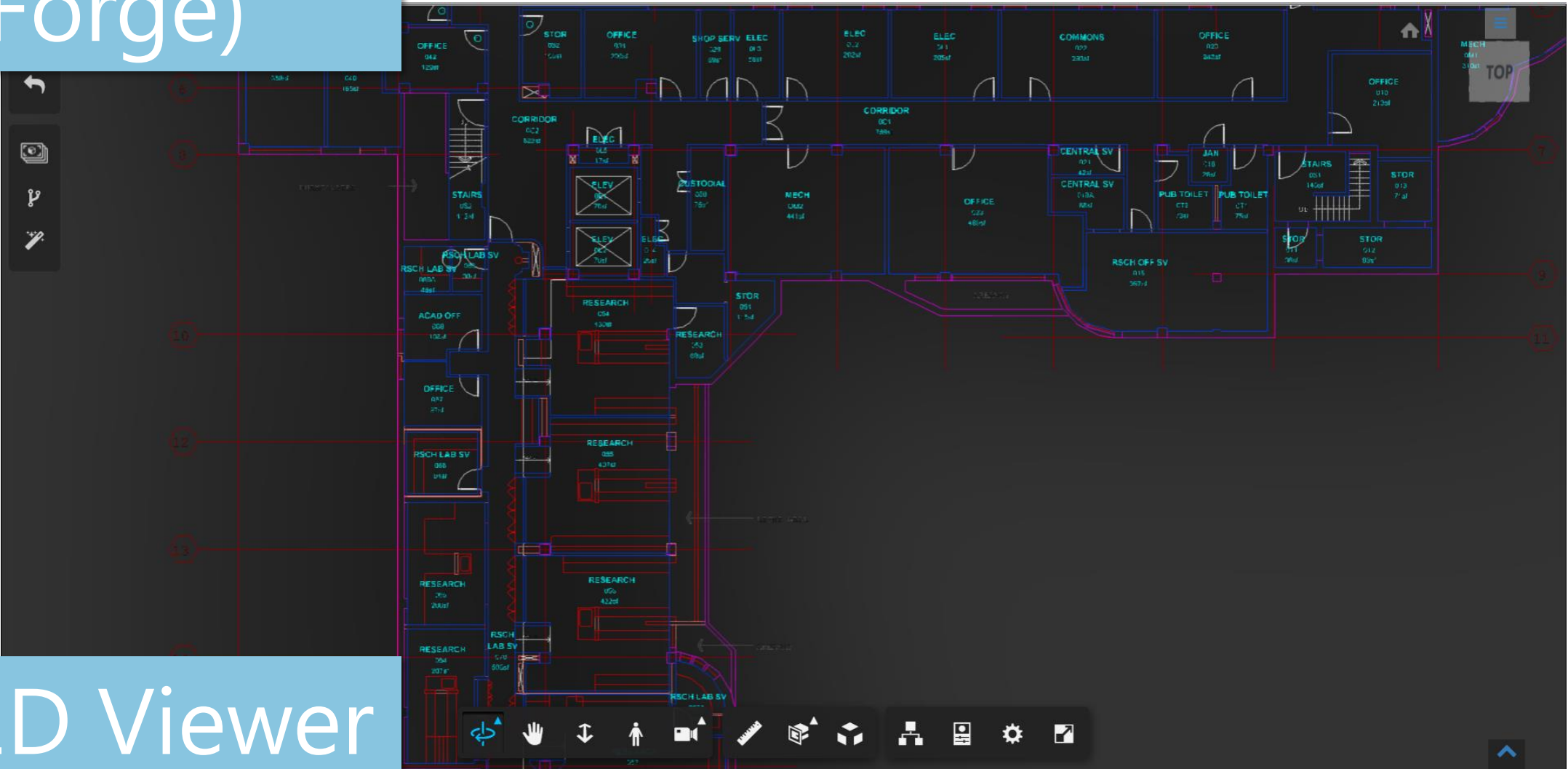


Multiple viewers

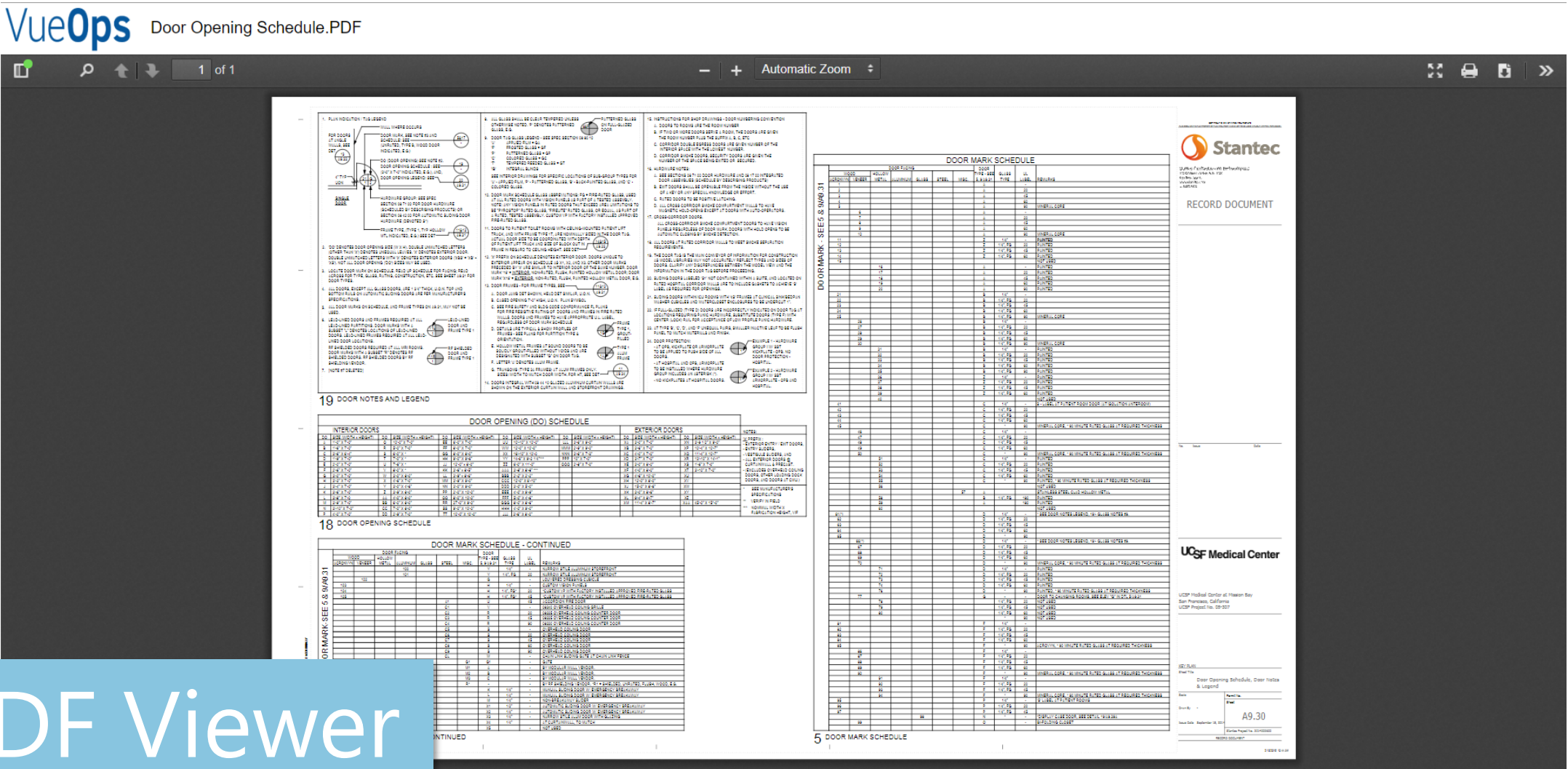
Improve access efficiency



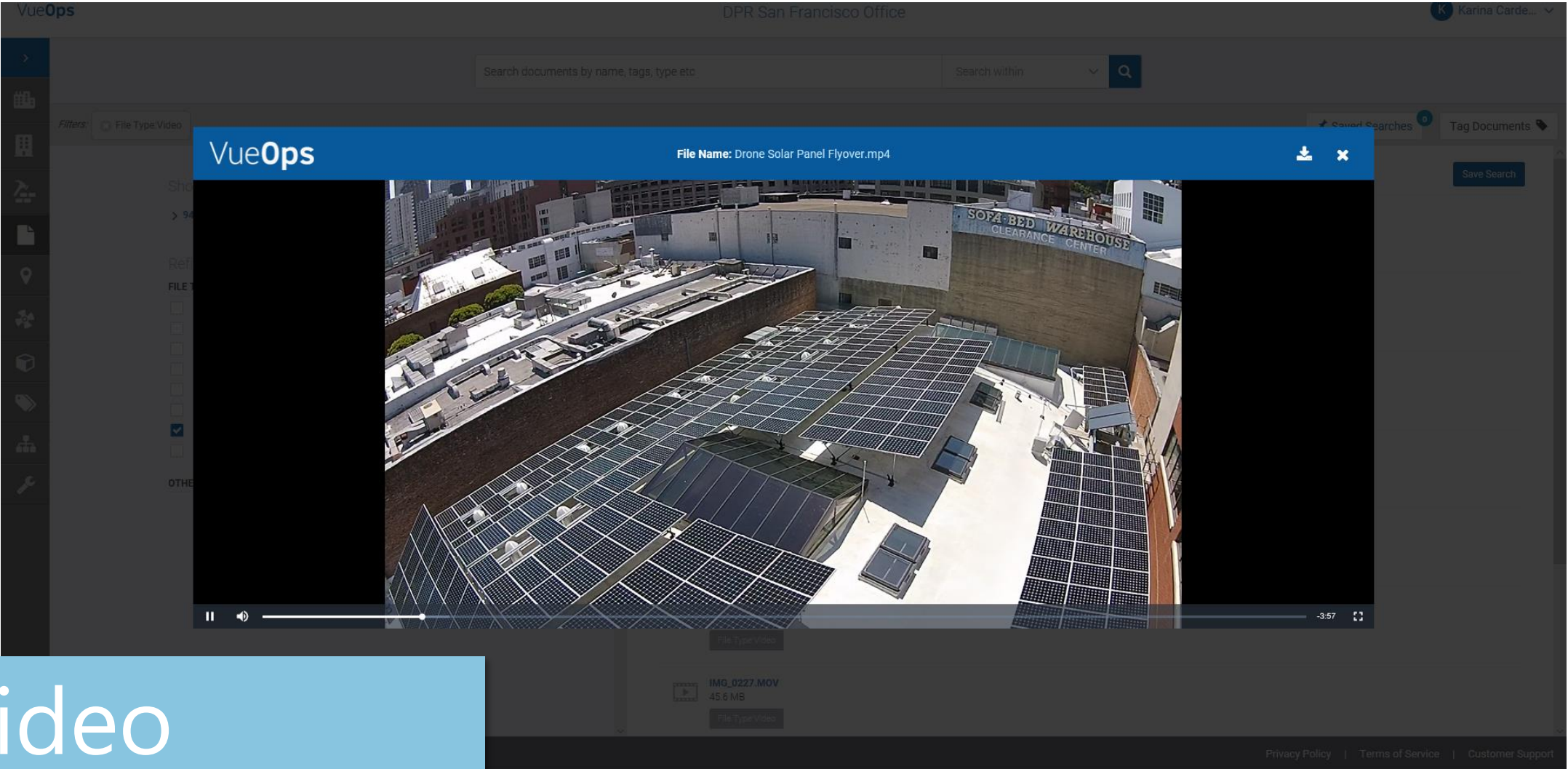
3D Viewer
(Forge)



2D Viewer



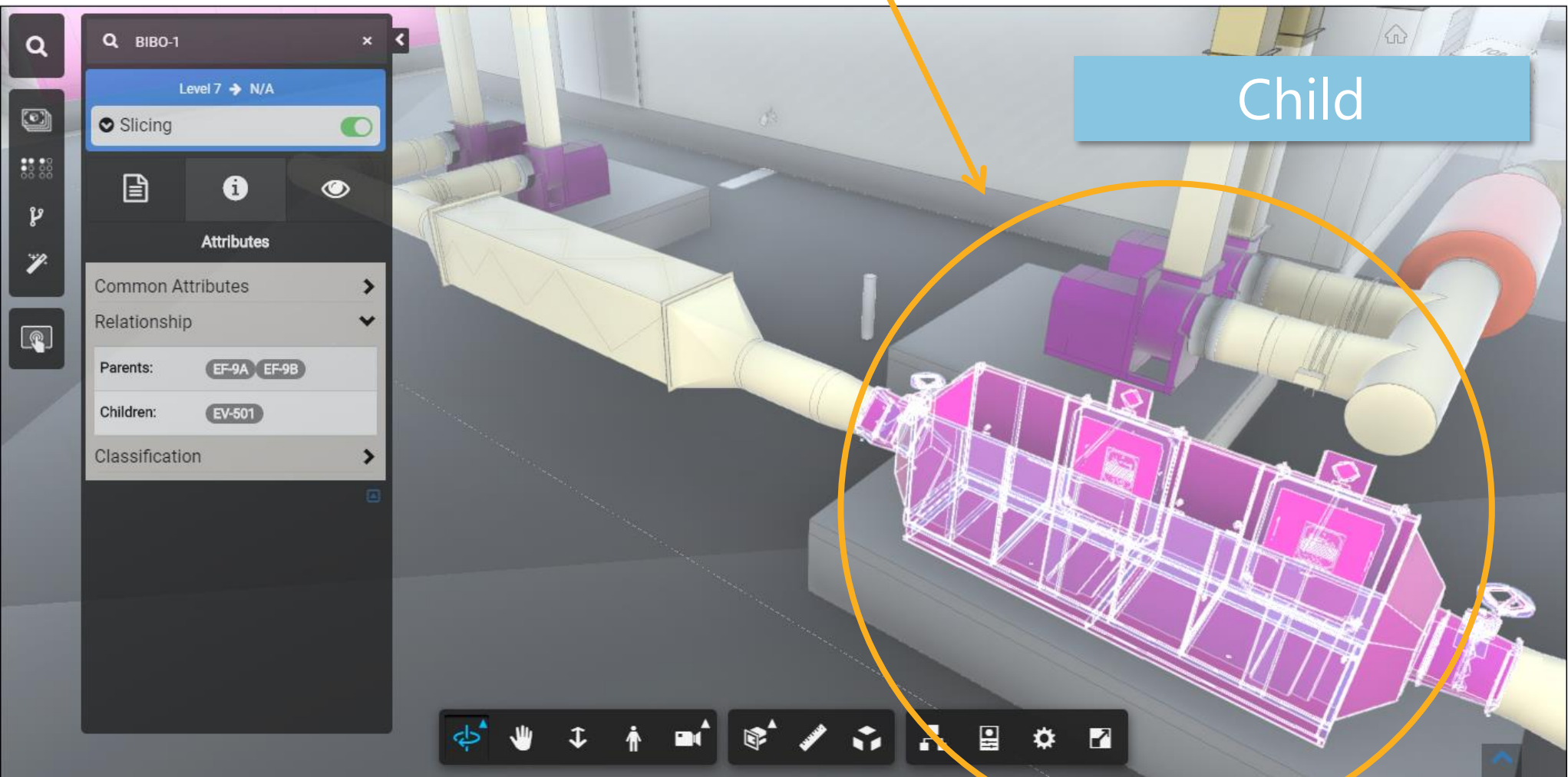
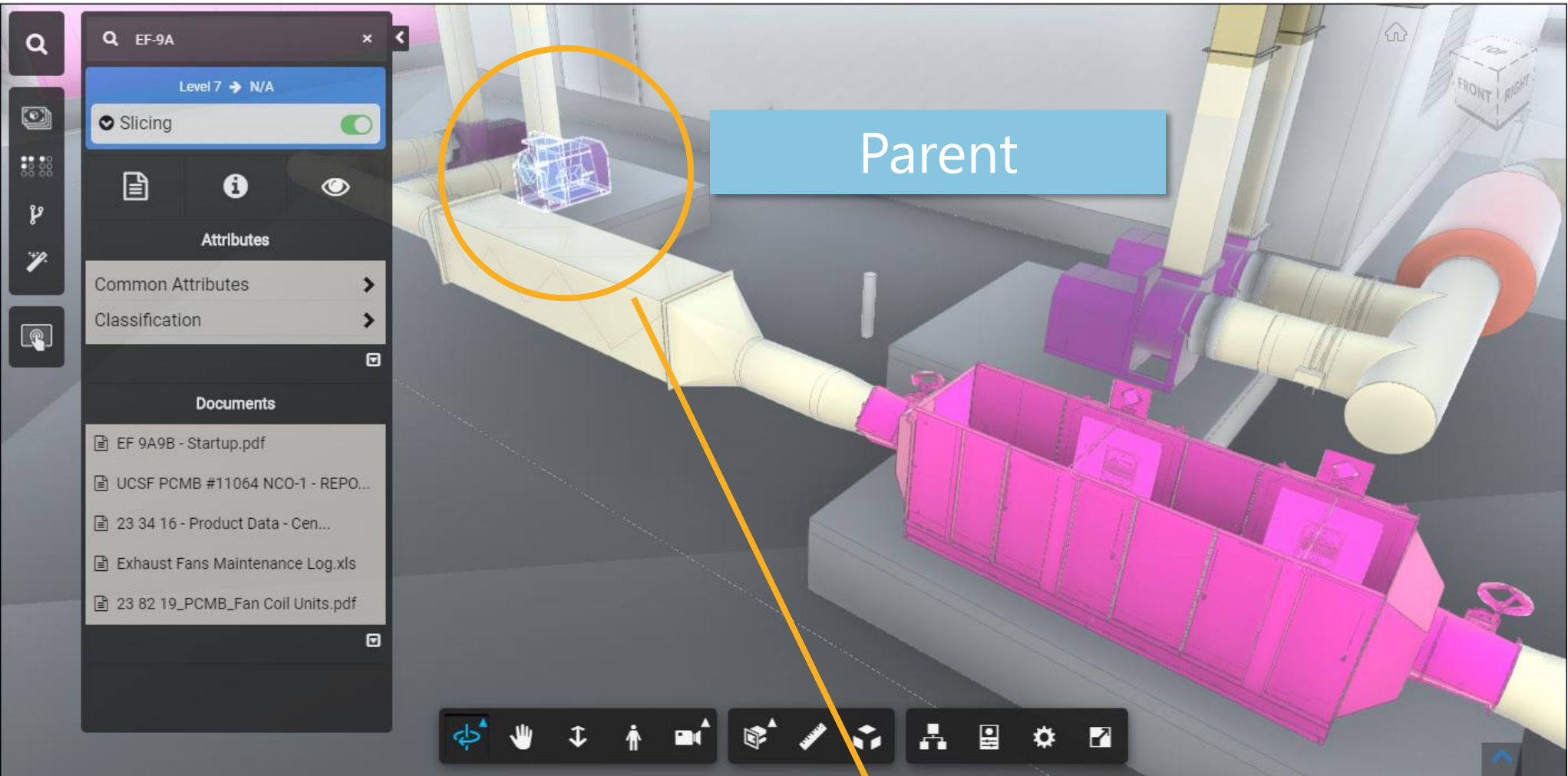
PDF Viewer



Video Viewer

Seeing upstream and downstream impacts

Help in minimizing disruptions



Assets Total:5265

Tag	Discipline	Category
Air Handling Units		
AHU-9		
AHU-7		
AHU-8		
Automatic Transfer Switches		
ATS-OSB		
ATS-EQ		
ATS-CR		
ATS-LS		
Bag Filters		
BIBO-1		
Constant Volume Air Terminal Units		
CE-622		
CE-115		

Bag Filters

Actions Edit Delete

Common Attributes

Relationship ▼

Parents: EF-9A EF-9B

Children: EV-501

Classification

Filter

Mechanical Equipment

VueOps in IBM Maximo™

VueOps Viewer complete functionality in Maximo

The screenshot displays the IBM Maximo VueOps interface. The top navigation bar includes a home icon, a hamburger menu, and the text "Locations". The right side of the top bar shows the user "MAXADMIN" and the IBM logo. Below the top bar is a search bar labeled "Find Location" and a "Find Navigation Item" bar. The main content area is divided into a left sidebar and a central 3D view. The sidebar contains sections for "Go To Applications", "Available Queries", "All Records", "All Bookmarks", "Common Actions" (New Location, Save Location, Clear Changes, Change Status, Create Report), and "More Actions" (View History, Create, Open Drilldown, Associate Systems with Location, Manage Systems, Apply Item Assembly Structure, View/Modify Parents, View Work Details, View Contracts, View Tickets, Enter Meter Readings, Manage Meter Reading History, Reset/Replace Meters, Associate Users and Custodians, Associate Services, Manage Location Collections, Attachment Library/Folders, Duplicate Location, Delete Location, Add to Bookmarks, Associate Time Zone, Run Reports, Cognos Reporting, View Building Model Import Sessions, and Inspect Asset Details). The central 3D view shows a building model with mechanical equipment. A sidebar on the left of the 3D view displays details for "AHU-9", including "Common Attributes" (Tag Name: AHU-9, Discipline: Mechanical Equipment, Category: Mechanical Equipment, Building, Asset Type: Air Handling Units) and "Relationship Classification". A "ClimateCraft" logo is visible above a list of documents: "PD-AHU.pdf", "O&M-AHU.pdf", "2019-01-31", and "M6.04_MECHA". A tooltip for "O&M-AHU.pdf" shows a thumbnail of a manual and the text "Installation, Operation and Maintenance Manual". The bottom of the 3D view has a toolbar with icons for navigation and interaction. The URL at the bottom is "https://viewer.vueops-qa.com/preview/189805/full".

VueOps' use of Forge APIs



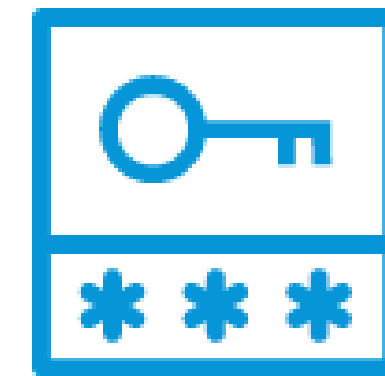
Viewer



Model Derivative



Data Management



Authentication



Webhooks



BIM 360



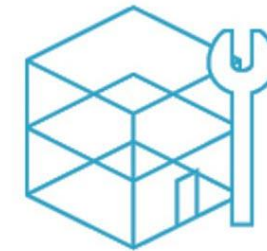
Quickly access
warranty data



Gather service
metrics and other
critical insights



Virtual investigation
of systems and
assets in their
locations



Provide value
of BIM beyond
construction

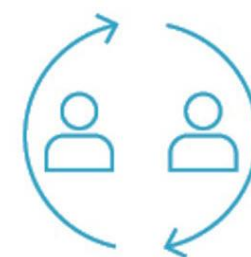
VueOps™



View information
as an enterprise,
building or project



Collect, organize,
and display design &
construction artifacts



Sustained
relationships with
clients



Increased
maintenance
productivity

How can you get started?

- Communicate the why
- Get in at the right time
- Keep the threshold low enough so you can cross it
- Build a roadmap
- Define success
- Find the right partners
- Learn and improve

The background of the image is an abstract, low-angle shot of modern architectural structures, possibly skyscrapers, rendered in a light blue, semi-transparent style. The lines of the buildings converge towards the top right, creating a sense of height and depth. The overall color palette is a range of blues, from very light to a deeper cerulean.

VueOpsTM

Know your building inside out

www.vueops.com



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