

Integration of BIM and Facility Maintenance: What Does the FM Crew Really Need?

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Class summary

This class will explain how the integration of BIM into FM systems has become a powerful tool in the building-management lifecycle. We will explain the correct workflow, what data is required and needed by FM crew and main advantages and disadvantages of Building Ops.

Flow of Information



Planning

BIM Requirements



Design

**Design Models
are Created**



Construction

**As-Built Models & Closeout
Documentation**



Maintenance

Turnover



- Why is this a challenge?**
- No Communication between FM crew and AEC
 - No Maintenance Schedules
 - Functionality and access of building systems
 - What data is imported into the FM systems
 - O&M and closeout documentation requirements
 - Understanding what data is in a model and reliability of that data

Deferred Maintenance

Is the practice of postponing maintenance activities of system and component replacements that are needed to extend the life of the facility to achieve its projected life expectancy.

Preventative maintenance

Is maintenance that is regularly performed on a piece of equipment to reduce the possibility of failing. Preventative maintenance is performed while the equipment is still working to achieve its projected life expectancy.
Example: replace or repair worn parts before they cause system failure.



Deferred Maintenance leads to:

- Increased overall costs of managing and operating facilities
- Increased incidence of unplanned, more costly and emergency repairs
- Failure of buildings and equipment, requiring significant capital expenditures
- Disruption of normal building operation, decreased users productivity
- Increased risk of defaults on warranties of equipment and building components

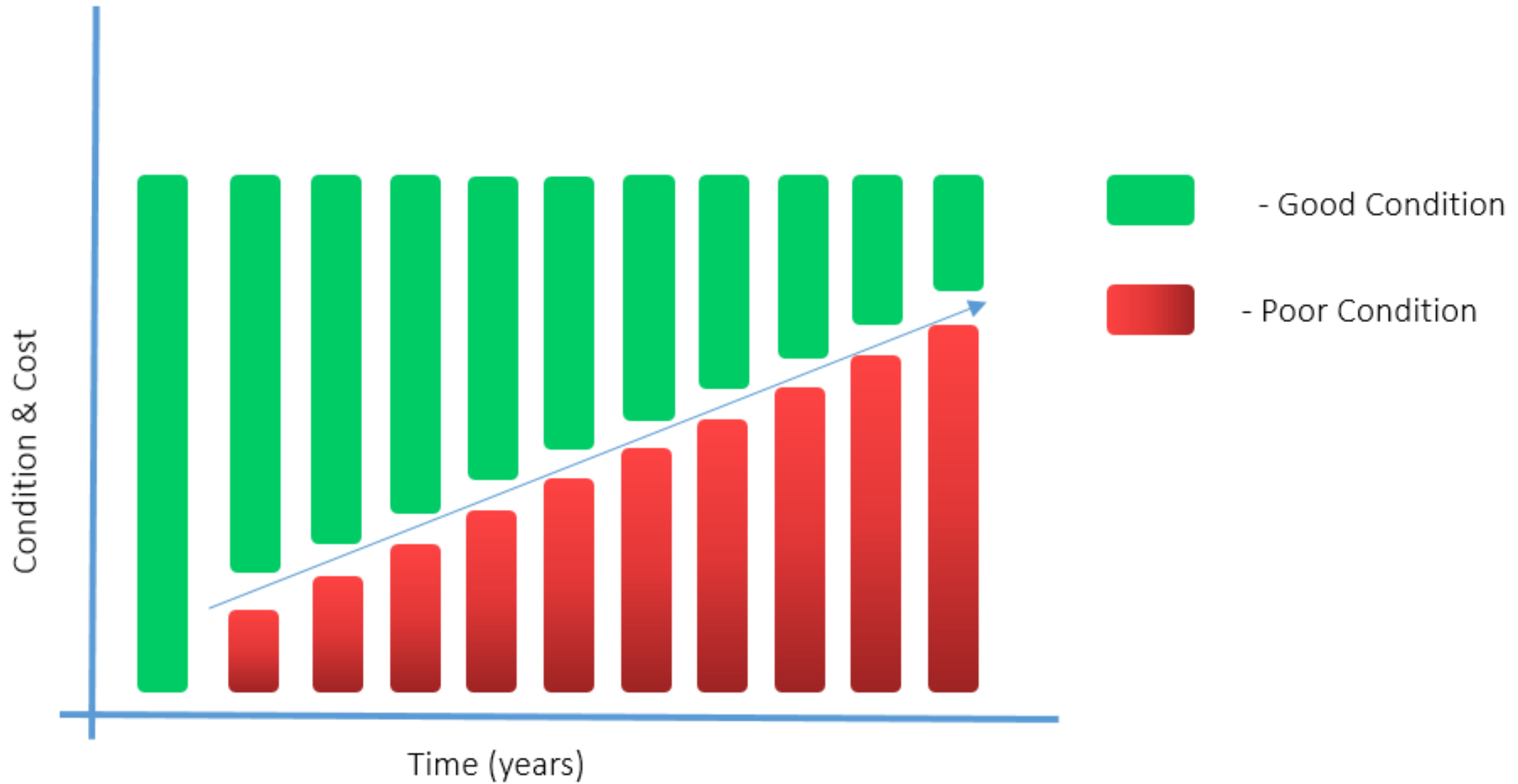


Council of the Great City Schools Report

- \$1 scheduled maintenance = \$5 deferred maintenance
- **\$271 billion** of deferred maintenance for nationwide for school districts - averaging \$4,883 per student
- SDUSD average facility is over **40 years** old



Facility Condition Graph



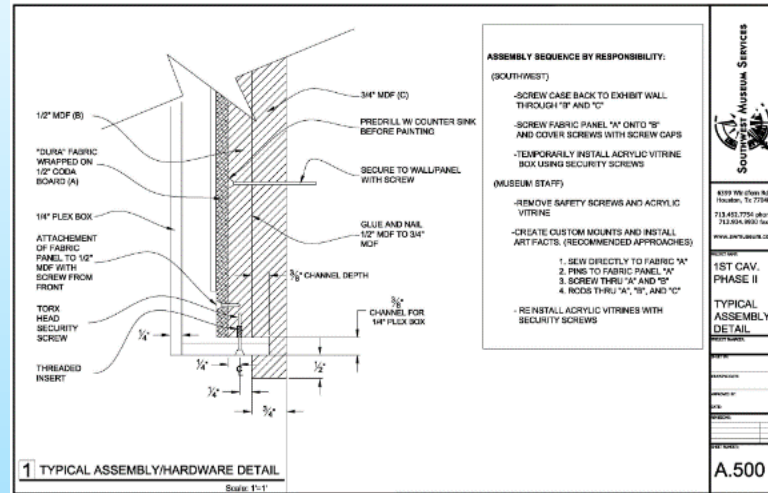
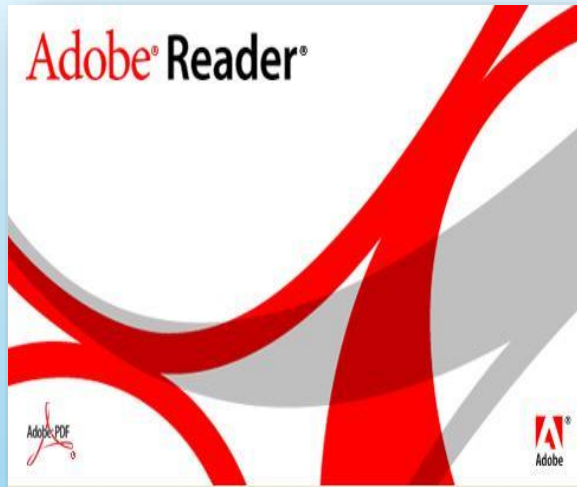
Project Closeout Process



Soon After ...





































































































Electronic Construction Documents




PROJECT NO. 09108	EDSWY MODERNIZATION PROJECT	PAGE 1
23 NOV-2013		SECTION 03 01 10
TABLE OF CONTENTS		
VOLUME #1		SECTION 03 01 10
DIVISION 03	PROCUREMENT AND CONTRACTING REQUIREMENTS	SECTION 03 01 10
DIVISION 06	TABLE OF CONTENTS	SECTION 03 01 10
DIVISION 01	GENERAL REQUIREMENTS	SECTION 03 01 10
01 10 00	SUMMARY	SECTION 03 01 10
01 10 01	GENERAL CONDITIONS REQUIREMENTS	SECTION 03 01 10
01 26 13	REQUEST FOR INTERPRETATION	SECTION 03 01 10
01 33 00	SUBMITTAL PROCEDURES	SECTION 03 01 10
01 33 16	UNCLASSIFIED DESIGN PROCEDURES	SECTION 03 01 10
01 35 00	REGULATED MATERIALS ABATEMENT SUBMITTALS	SECTION 03 01 10
01 35 15	USED REQUIREMENTS	SECTION 03 01 10
01 40 00	QUALITY REQUIREMENTS	SECTION 03 01 10
01 57 13	TEMPORARY EROSION AND SEDIMENT CONTROL	SECTION 03 01 10
01 57 21	INSURANCE QUALITY CONTROLS	SECTION 03 01 10
01 60 00	PRODUCT REQUIREMENTS	SECTION 03 01 10
01 70 00	EXCUT OR AND CLOSURE REQUIREMENTS	SECTION 03 01 10
01 74 19	CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL	SECTION 03 01 10
01 76 00	CLOSURE SUBMITTALS	SECTION 03 01 10
DIVISION 05	EXISTING CONDITIONS	SECTION 03 01 10
02 41 00	SELECTIVE DEMOLITION	SECTION 03 01 10
02 82 13	ASBESTOS ABATEMENT	SECTION 03 01 10
02 80 00	LEAD-CONTAINING PAINTS AND COATINGS	SECTION 03 01 10
02 84 10	UNDESIRABLE WASTES REMOVAL AND DISPOSAL	SECTION 03 01 10
DIVISION 05	CONCRETE	SECTION 03 01 10
02 30 00	CONCRETE IN PLACE	SECTION 03 01 10
02 45 00	PRECAST ARCHITECTURAL CONCRETE	SECTION 03 01 10
02 45 10	SITE CAST CONCRETE PLANS	SECTION 03 01 10
02 54 00	CAST-IN-PLACE CONCRETE	SECTION 03 01 10
DIVISION 04	MASONRY	SECTION 03 01 10
04 20 00	UNIT MASONRY	SECTION 03 01 10
DIVISION 05	METALS	SECTION 03 01 10
05 12 00	STRUCTURAL STEEL	SECTION 03 01 10



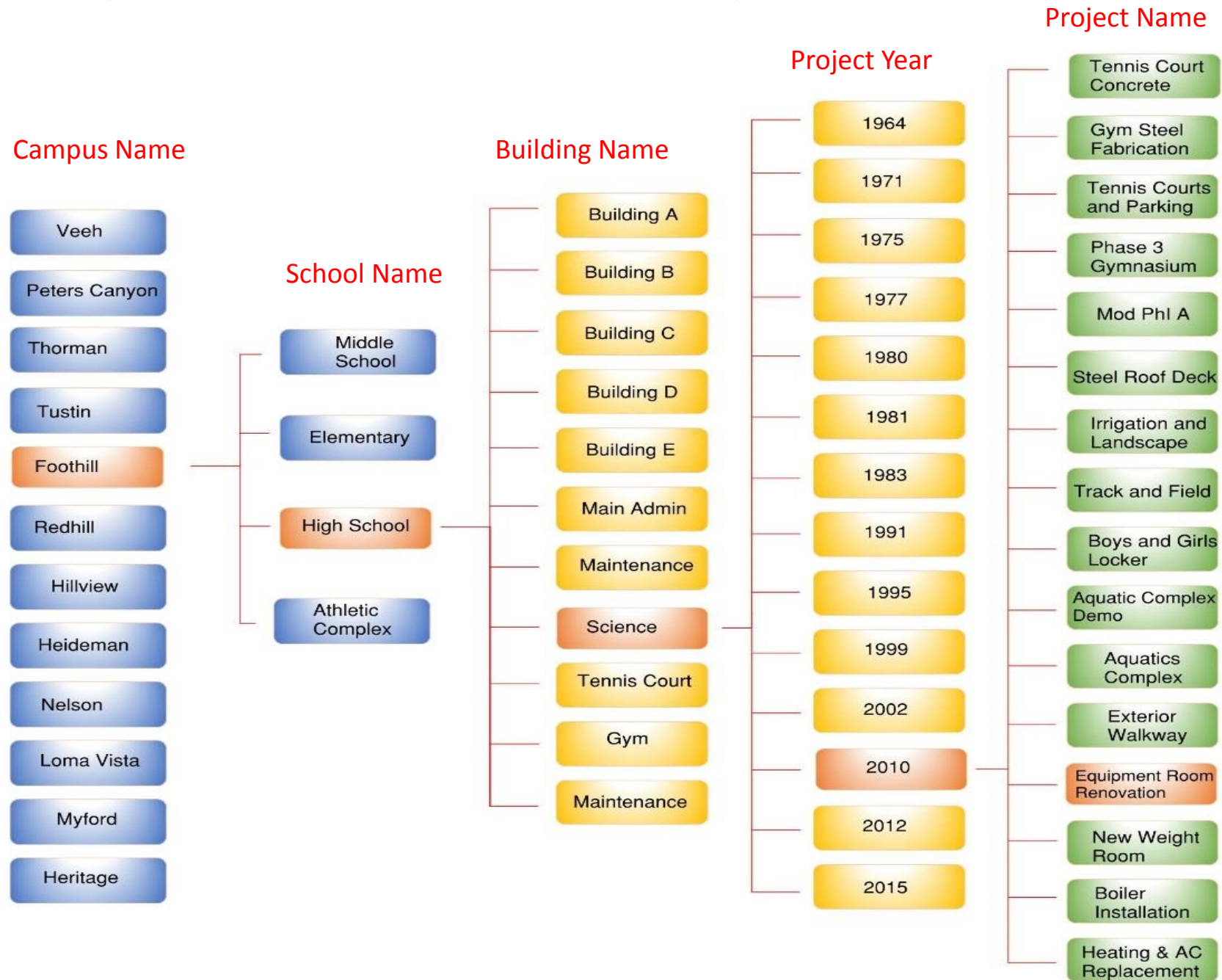
Find The Right Drawing

 2.22.13 Construction Set Constructability Review Comments File folder	 08.02.2012 Bid Day Bids File folder	 Accounting File folder	 APCD File folder	 Archive - Plans and Specs File folder	 As-Built File folder	 ASI Log File folder
 AUDIT DOCS 2015 File folder	 AV Bid package File folder	 Bidder's Manual File folder	 BIM Coordination File folder	 BIM Files File folder	 BSCC File folder	 Budgets File folder
 Camera Views File folder	 CCS Issues Logs File folder	 Central Plant Bypass Valve File folder	 City of Santee File folder	 Closeout Documents File folder	 Commissioning File folder	 Connor's Documents 6.9.14 File folder
 Constructability File folder	 Correspondence File folder	 County of San Diego-Ground Lease File folder	 Craig File folder	 DEH phase 2 reports File folder	 Demo Bid File folder	 Demo Bids 2014 File folder
 Design Development Bid File File folder	 Design Development Bids File folder	 Design Documents File folder	 Fences and Gates File folder	 FF&E File folder	 Field Change Requests File folder	 FiM File folder
 Fire Alarm History and Cleanliness Report 031715 File folder	 Fire Marshall File folder	 Forms File folder	 Hyperlinking File folder	 Imperial photos File folder	 Iron Mountain Scan File folder	 Issues File folder
 Job Site Visitor Sign-in File folder	 LEED File folder	 Luker Docs File folder	 Meetings File folder	 Millwork Scope Evaluation for 1.21.13 Meeting File folder	 Miscellaneous File folder	 Monthly Reports File folder
 Navisworks Freedom 2013 File folder	 NOT FOR CONSTRUCTION - Digital Documents File folder	 O&M's-CLOSEOUT DOCS-PHASE1 File folder	 OCIP File folder	 OCIP - By Sub File folder	 Office365ProPlus File folder	 Operational Excellence Reports File folder
 Parker Email File folder	 Permits File folder	 Phase 1 Showers File folder	 Phase 2 site utility plan File folder	 PHASE 2 SOVs File folder	 Pictures File folder	 PMR Docs File folder
 Pre con File folder	 Pre Permit Redlined Structural Sheets 12192012 File folder	 Preconstruction Meetings File folder	 PRINT O&Ms File folder	 Procedures File folder	 Procurement File folder	 Project Engineers File folder
 Purchase Order Log File folder	 QC DOCS File folder	 Reference File folder	 RFI Tracking File folder	 Safety File folder	 Schedule File folder	 Scopes from DD File folder
 SD County File folder	 SDCWDF Digital Docs File folder	 SDCWDF Site Photos File folder	 SeaWorld File folder	 Security Background Checks File folder	 SFM File folder	 Shirkey File folder
 Shop Drawings for Construction File folder	 Site Plans File folder	 South Bay Design Assist RFIs File folder	 Southern Folgers Issues Log File folder	 Specs (Consolidated Copy) File folder	 Sub CO Log File folder	 Subcontractors File folder
 Superintendents File folder	 SWPPP File folder	 Training Videos File folder	 Warranty Tracker File folder	 Weekly Work Plan File folder	 Western Bay Correspondence File folder	 Bid Package Breakdown Microsoft Excel 97-2003 Worksheet





School District Folder Structure





DASHBOARD

EDITH GREEN WENDELL WYATT
FEDERAL BUILDING MODERNIZATION

DRAWINGs

IOCs

CADs

SPECIFICATIONs

PHOTOs

REVIT MODEL

RFIs

FACILITY
REFERENCE

NAVISWORKS
MODEL

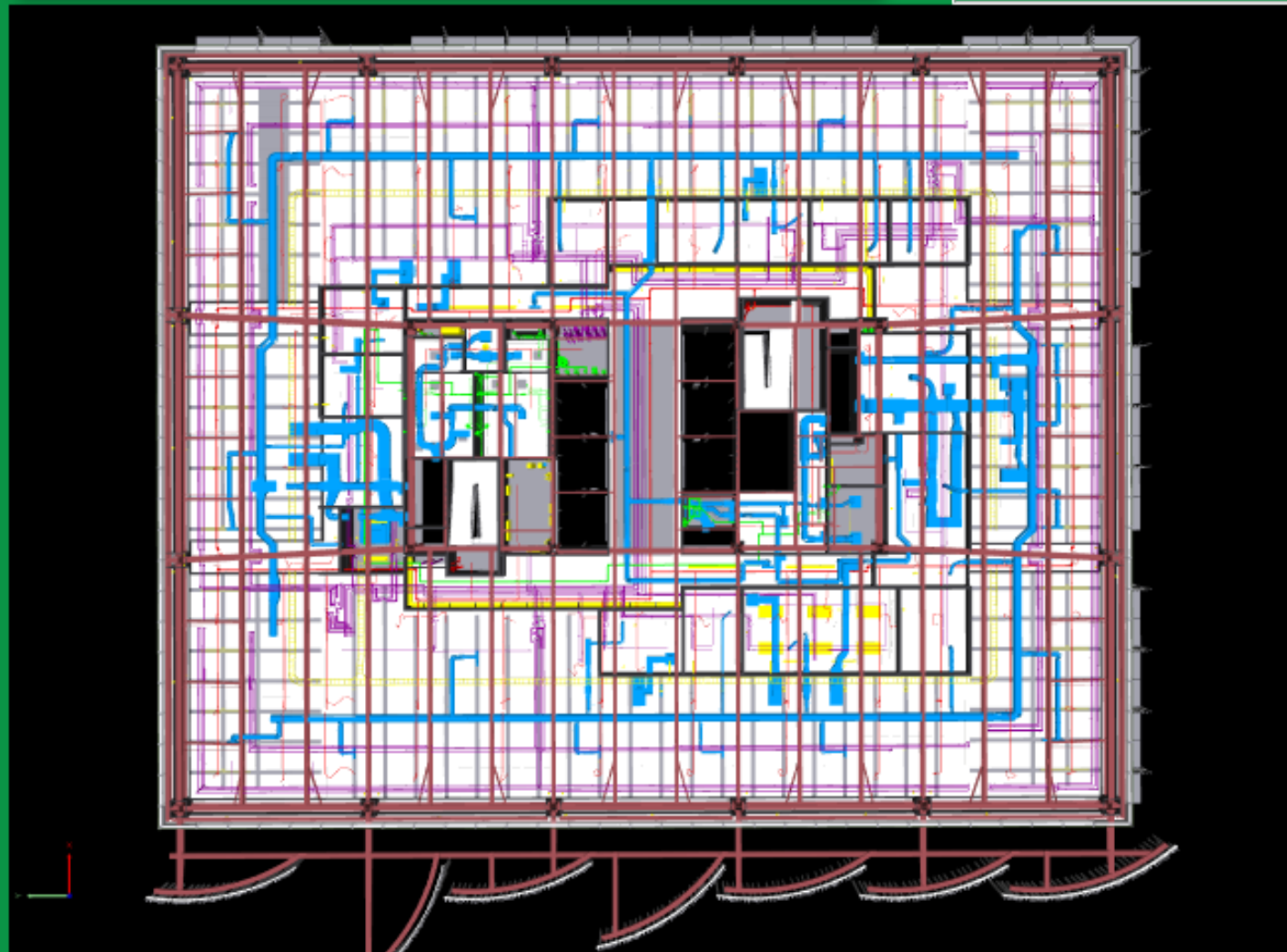
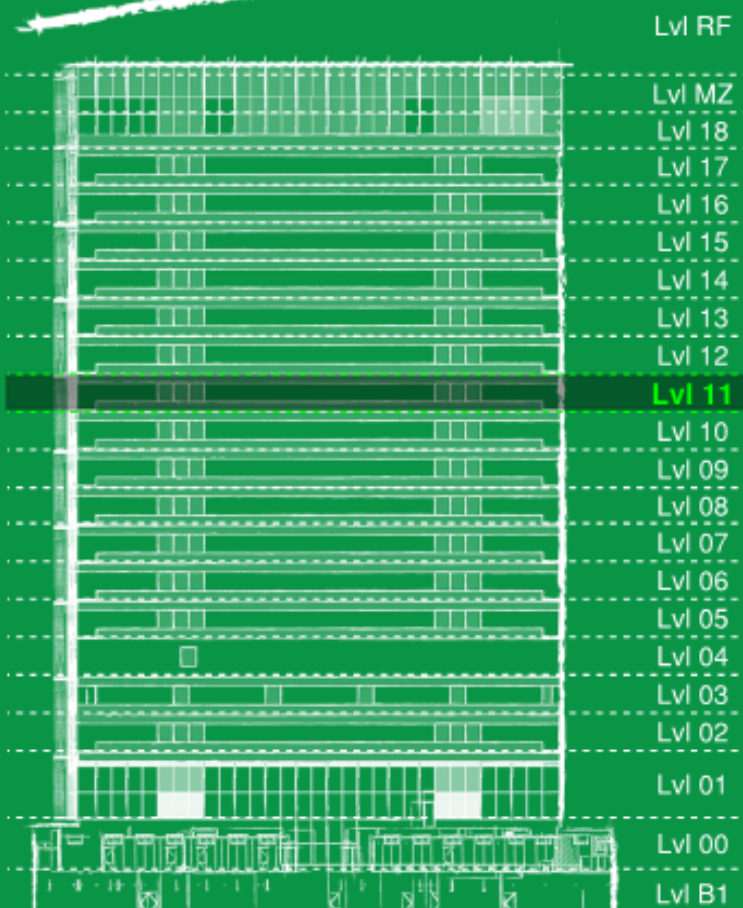
PROJECT INFORMATION

HELP

Balfour Beatty
Construction



EDITH GREEN-WENDELL WYATT
FEDERAL BUILDING MODERNIZATION



DIGITAL DOCUMENT LINKS

QUICK REFERENCE

O&M INDEX

MODEL COMPONENT VISIBILITY CONTROL

☒ Architectural

☒ Exterior Skin

☒ Structural

☒ Sheet Metal (model)

☐ Sheet Metal (annotation)

☒ Electrical

☒ Fire Protection

☒ Plumbing

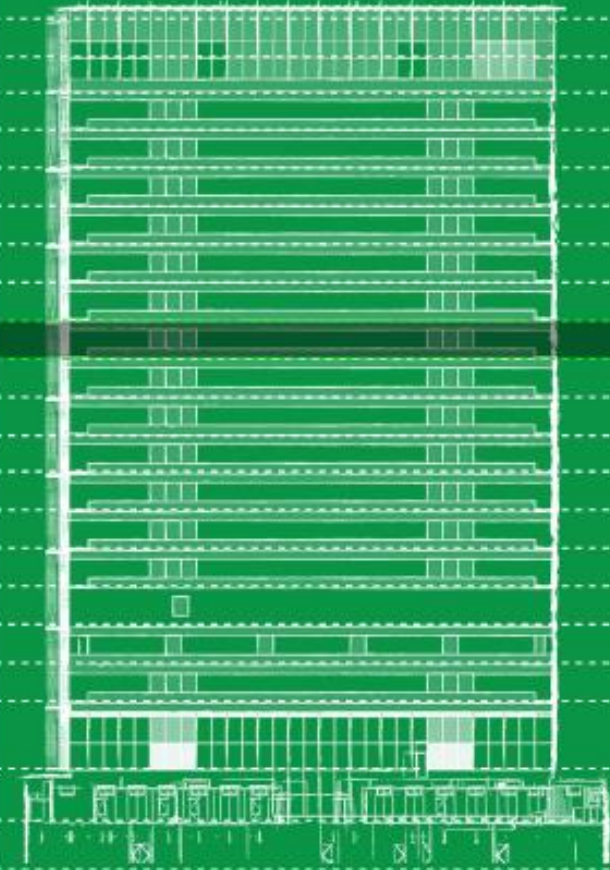
☒ Mechanical Pipe



EDITH GREEN-WENDELL WYATT
FEDERAL BUILDING MODERNIZATION



RESET VIEWER



Lvl RF

Lvl MZ

Lvl 18

Lvl 17

Lvl 16

Lvl 15

Lvl 14

Lvl 13

Lvl 12

Lvl 11

Lvl 10

Lvl 09

Lvl 08

Lvl 07

Lvl 06

Lvl 05

Lvl 04

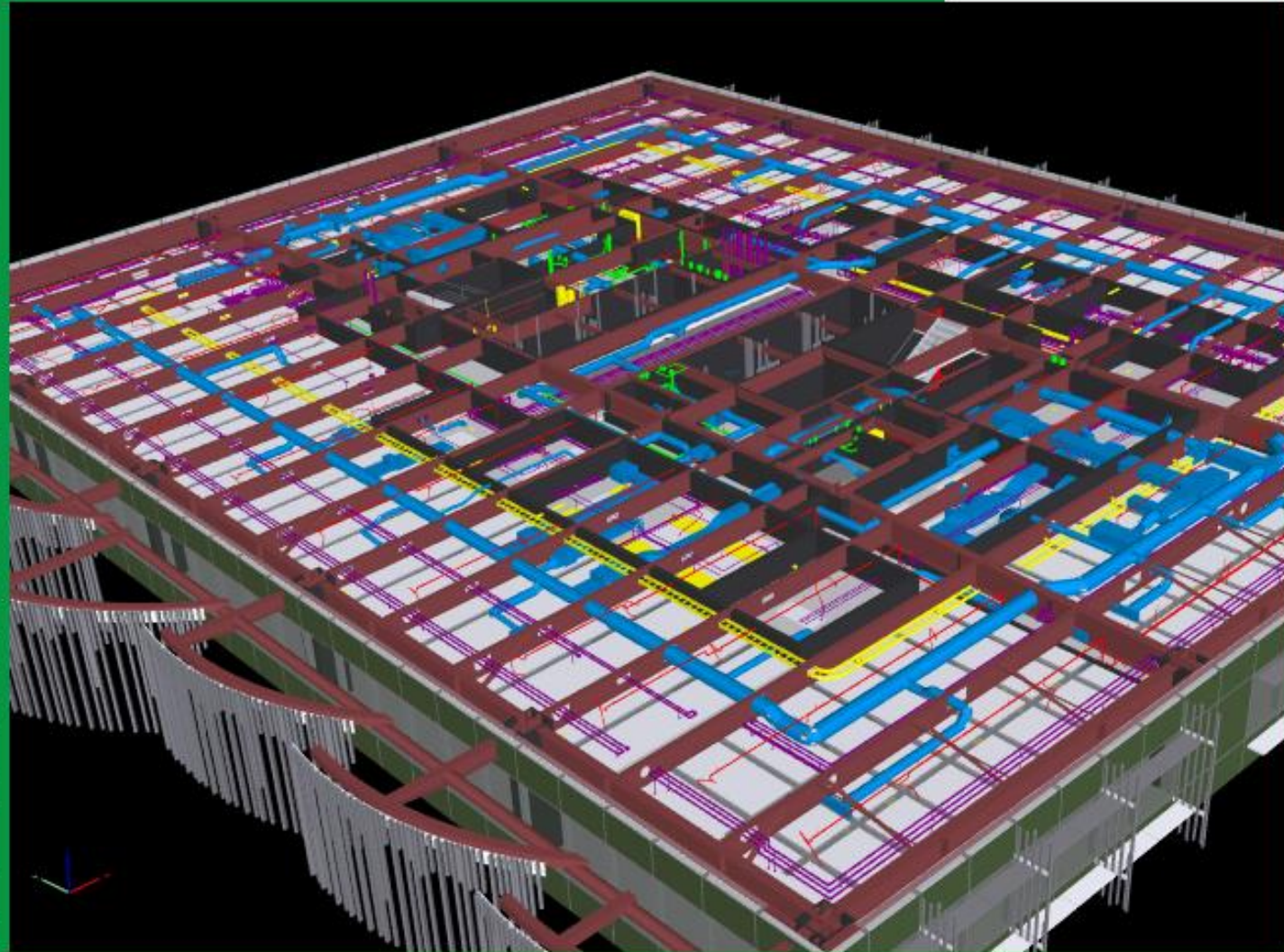
Lvl 03

Lvl 02

Lvl 01

Lvl 00

Lvl B1



DIGITAL DOCUMENT LINKS



QUICK REFERENCE



O&M INDEX

MODEL COMPONENT VISIBILITY CONTROL

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☒ Plumbing

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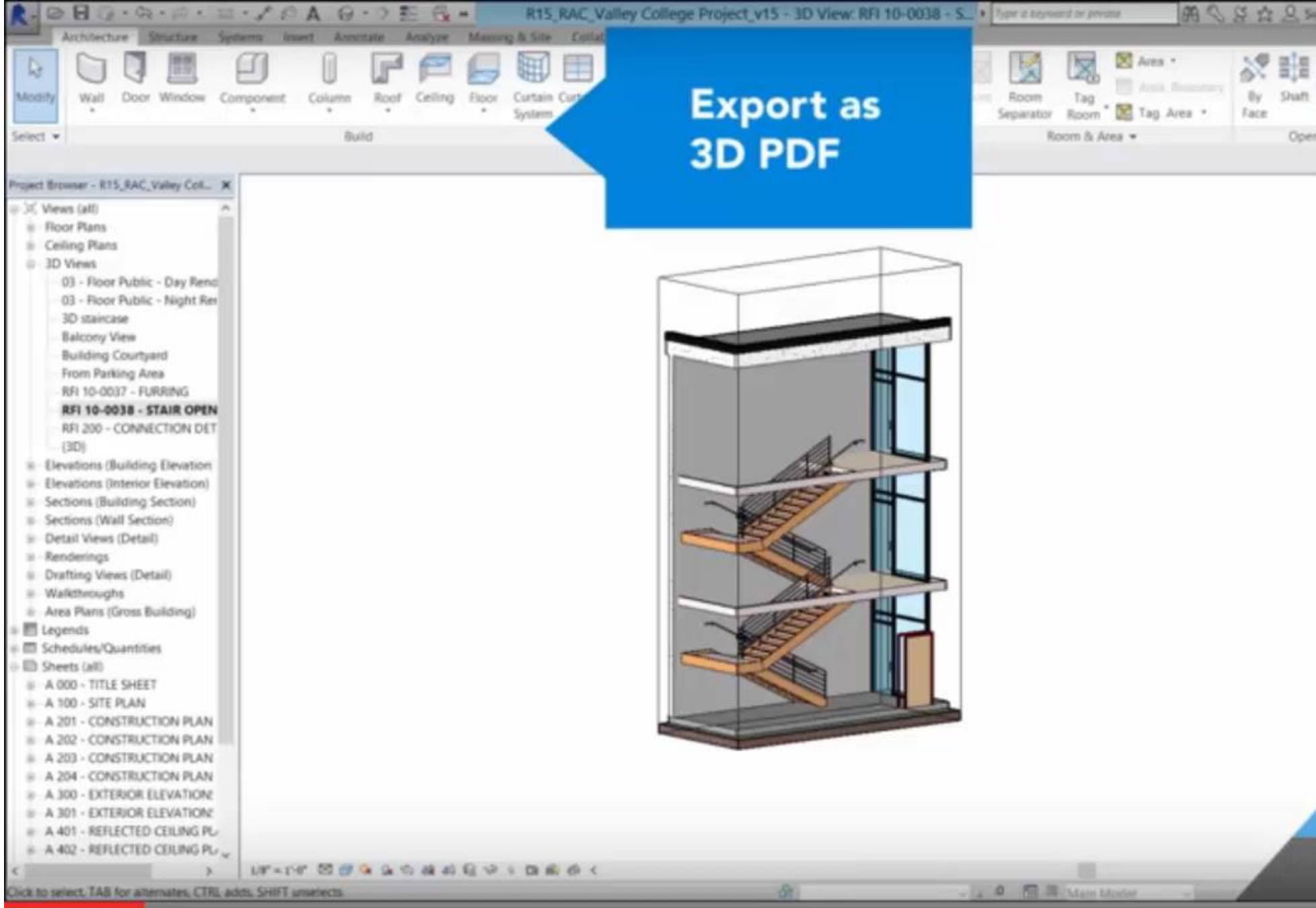
☐ Sheet Metal (annotation)

☒ Mechanical Pipe



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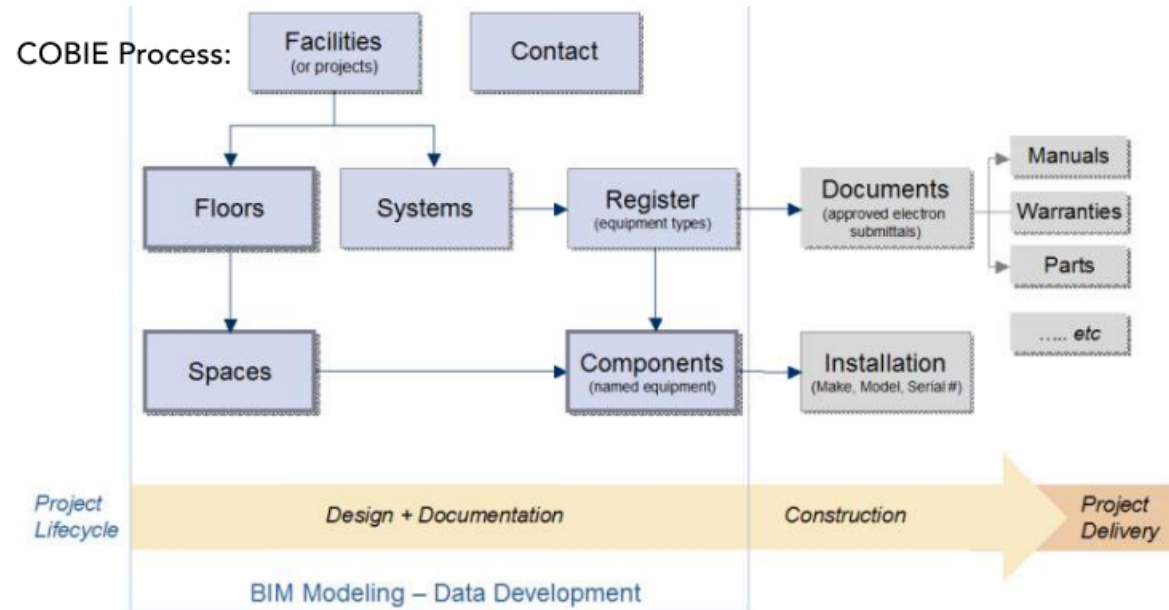




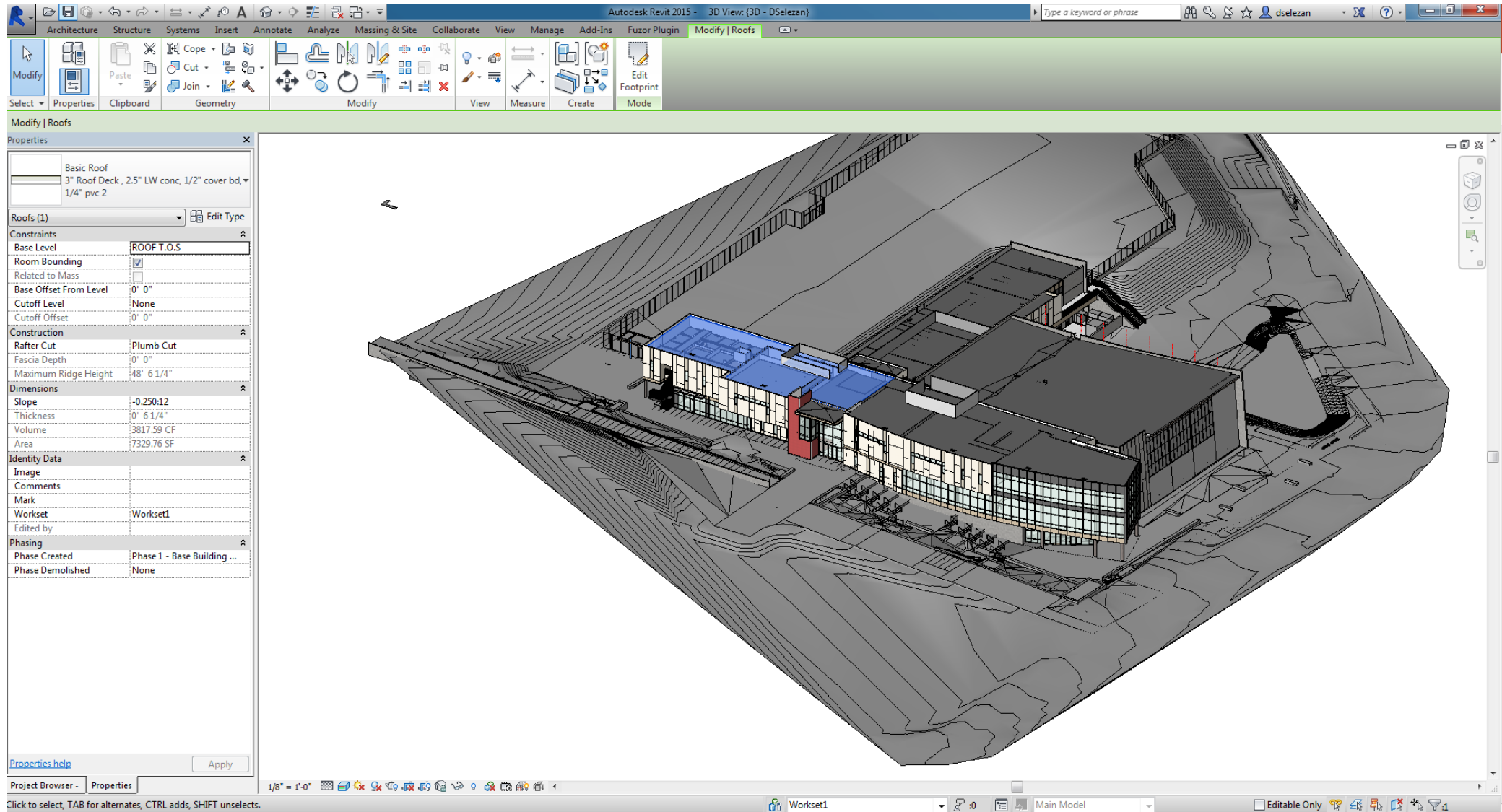
BIM Requirements – BIM Specifications

COBIE

The "Construction Operations Building Information Exchange" or COBIE spreadsheet is to replace submission of multiple copies of paper documents delivered at the conclusion of construction projects with a set of small Portable Document Format (PDF) or other appropriate formatted files. The data required by COBIE is the same information as is currently required by project hand over specifications. The COBIE approach is to enter the data as it is created during the design, construction and commissioning process. The design team shall submit to SDCCD in spreadsheet format using the most current version of COBIE. The COBIE spreadsheet and information on how to use COBIE can be found at <http://www.wbdg.org/tools/cobiex.php>.



Native Files



Revit



COBie-UK-2012-example1.xls [Compatibility Mode] - Microsoft Excel

	A	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD
	Name	ExtIdentifier	ReplacementCost	ExpectedLife	DurationUnit	WarrantyDescription	NominalLength	NominalWidth	NominalHeight	ModelReference	Shape	Size	Color	Finish	Grade	Material
1																
2	1810 x 2110mm	1CDIQ4E3	n/a	n/a	year	n/a	1810.0	150.0	2110.0	Generic Int DD:1810 x 2110mm	n/a	n/a	n/a	n/a	n/a	Generic
3	790 x 2110mm 3	1uSEcSY8	n/a	n/a	year	n/a	790.0	150.0	2110.0	Generic Int D Cell Door:790 x 2110mm	n/a	n/a	n/a	n/a	n/a	Generic
4	Cell Bed family	0uCr33MT	n/a	n/a	year	n/a	2000.0	700.0	400.0	n/a	n/a	n/a	n/a	n/a	n/a	n/a
5	Desk Whitewood	0uCr33MT	n/a	n/a	year	n/a	1360.0	450.0	900.0	n/a	n/a	n/a	n/a	n/a	n/a	n/a
6	Cell Locker	0uCr33MT	n/a	n/a	year	n/a	500.0	450.0	1000.0	n/a	n/a	n/a	n/a	Whitewood	n/a	Whitewood
7	Safer Seat	0uCr33MT	n/a	n/a	year	n/a	500.0	500.0	500.0	n/a	n/a	n/a	n/a	n/a	n/a	n/a
8	1275x1200h	1ZA_U6n	n/a	n/a	year	n/a	1275.0	340.0	1200.0	Safer Cell 7 Bay FF:1275x1200h	n/a	n/a	n/a	Generic	n/a	n/a
9	Basic Wall:Generic Ext - 150mm	n/a	n/a	n/a	year	n/a	1000.0	150.0	2700.0	n/a	n/a	n/a	n/a	n/a	n/a	n/a
10	Basic Wall:Generic Ext - 340mm	n/a	n/a	n/a	year	n/a	1000.0	340.0	2700.0	n/a	n/a	n/a	n/a	n/a	n/a	n/a
11	Basic Wall:Generic Ext - 80mm	n/a	n/a	n/a	year	n/a	1000.0	80.0	2675.0	n/a	n/a	n/a	n/a	n/a	n/a	n/a
12	Concrete (Painted)	n/a	n/a	n/a	year	n/a	1000.0	1000.0	1000.0	n/a	n/a	n/a	n/a	n/a	n/a	n/a
13	Generic	n/a	n/a	n/a	year	n/a	1000.0	1000.0	1000.0	n/a	n/a	n/a	n/a	n/a	n/a	n/a
14	Generic Inserts	n/a	n/a	n/a	year	n/a	1000.0	1000.0	1000.0	n/a	n/a	n/a	n/a	n/a	n/a	n/a
15	Material Brickwork	n/a	n/a	n/a	year	n/a	1000.0	1000.0	1000.0	n/a	n/a	n/a	n/a	n/a	n/a	n/a
16	TFT Monitor	n/a	n/a	n/a	year	n/a	400.0	75.0	400.0	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Ready

COBie

← → ↻ <https://secure.constructware.com/Main.aspx> ☆ G ☰

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Menu Favorite Projects SWC Wellness & Aquatic Complex [13397] [Configure](#)

Company Links View Send New Edit Multi-Edit Void Copy Respond Process Revise Form Letter Comments History Reports

Personal Organizer Previous Next Filter [No Filter Applied] Show 20 items Show Voided

Reporting (none) contains

Project Information

Project Organizer

Project Tasks

Project Calls

Project Inbox

Project Outbox

File Management

File Director

Document Management

ASIs

Correspondence

Daily Reports

Design Review

Documents

Drawing Log

Issues

Meetings

Permits

RFIs

Submittals

Transmittals

Cost Management

Contractors

Maintenance

Help

Items 1-20 of 163

No.	Primary Responder	Subject	From	Date	Responded	Status	Contractor RFI
142	King, Richard (Gensler)	INC-2 - Edge of Slab Clips Connection	Fagerstrom, Andrea (Balfour Beatty Construction, LLC)	8/26/2016		Internal Review	
141	King, Richard (Gensler)	INC-2 - Title 24 Clarifications	Fagerstrom, Andrea (Balfour Beatty Construction, LLC)	8/26/2016		Internal Review	
134	King, Richard (Gensler)	INC 2 - 4" sewer line in Segment B GL 10 & C	Fisher, Becky (Balfour Beatty Construction, LLC)	8/26/2016		Submitted	
128R1	King, Richard (Gensler)	INC-2 - Room 223 - Light Fixture L03 Location	Fagerstrom, Andrea (Balfour Beatty Construction, LLC)	8/26/2016		Affect Letter	
080R1	King, Richard (Gensler)	INC 2 - Revised Parking Lot J Elevations	Fisher, Becky (Balfour Beatty Construction, LLC)	8/26/2016		Submitted	
113R1	King, Richard (Gensler)	INC-2 - Site Work - Truncated Domes	Fagerstrom, Andrea (Balfour Beatty Construction, LLC)	8/25/2016		Internal Review	
058R2	King, Richard (Gensler)	INC-2 - Segment A - Dimension Clarifications	Fagerstrom, Andrea (Balfour Beatty Construction, LLC)	8/25/2016		Internal Review	
140	King, Richard (Gensler)	U/G Hydronic Piping Conflict	Jacuanillo, Ken (Balfour Beatty Construction, LLC)	8/24/2016		Submitted	
139	King, Richard (Gensler)	INC-2 - Missing dimensions for warm water pool ...	Fisher, Becky (Balfour Beatty Construction, LLC)	8/24/2016		Submitted	
138	King, Richard (Gensler)	INC-2 - Door 153B Size	Fagerstrom, Andrea (Balfour Beatty Construction, LLC)	8/24/2016		Submitted	
136	King, Richard (Gensler)	INC-2 - Location of P3B in Room 310	Fagerstrom, Andrea (Balfour Beatty Construction, LLC)	8/23/2016		Submitted	
137	King, Richard (Gensler)	INC-2 - Extended Footing at Cast-In-Place Wall ...	Fagerstrom, Andrea (Balfour Beatty Construction, LLC)	8/22/2016		Submitted	
131	King, Richard (Gensler)		Fisher, Becky (Balfour Beatty Construction, LLC)	8/19/2016			
135	King, Richard (Gensler)	INC 2 - Truss Splice Access Hole Confirmation	Jaenicke, Jake (Balfour Beatty Construction, LLC)	8/18/2016	8/23/2016	Submitted	
133	King, Richard (Gensler)	INC 2 - Warming Pool Skimmer Reinforcing Steel	Fisher, Becky (Balfour Beatty Construction, LLC)	8/18/2016	8/19/2016	Submitted	
132	King, Richard (Gensler)	INC-2 - Segment A - Tilt Up Panels Detail L/S3.0	Fagerstrom, Andrea (Balfour Beatty Construction, LLC)	8/18/2016	8/25/2016	Submitted	
130	King, Richard (Gensler)	INC 2 - Segment B 8" Roof Drain and 8" Overflow...	Fisher, Becky (Balfour Beatty Construction, LLC)	8/17/2016		Submitted	
129	King, Richard (Gensler)	INC 2 - Water Closets in Rooms 213, 215, 305, 321	Fisher, Becky (Balfour Beatty Construction, LLC)	8/17/2016	8/19/2016	Internal Review	
128	King, Richard (Gensler)	INC-2 - Room 223 - Light Fixture L03 Location	Fagerstrom, Andrea (Balfour Beatty Construction, LLC)	8/17/2016	8/19/2016	Affect Letter	
127	King, Richard (Gensler)	INC-2 - Added Rebar at Panel 27	Fagerstrom, Andrea (Balfour Beatty Construction, LLC)	8/17/2016	8/17/2016	Affect Letter	

Items 1-20 of 163

CM Software



<div><div>AS BUILT</div></div>			J
DRAWING NUMBER			K
42-C-0035			
VENDOR DRAWING NUMBER			
SIZE	SCALE	REV	



Project: EGWW

Contractor: McKinstry Comapny

TAG: CP-4 / CDP-2

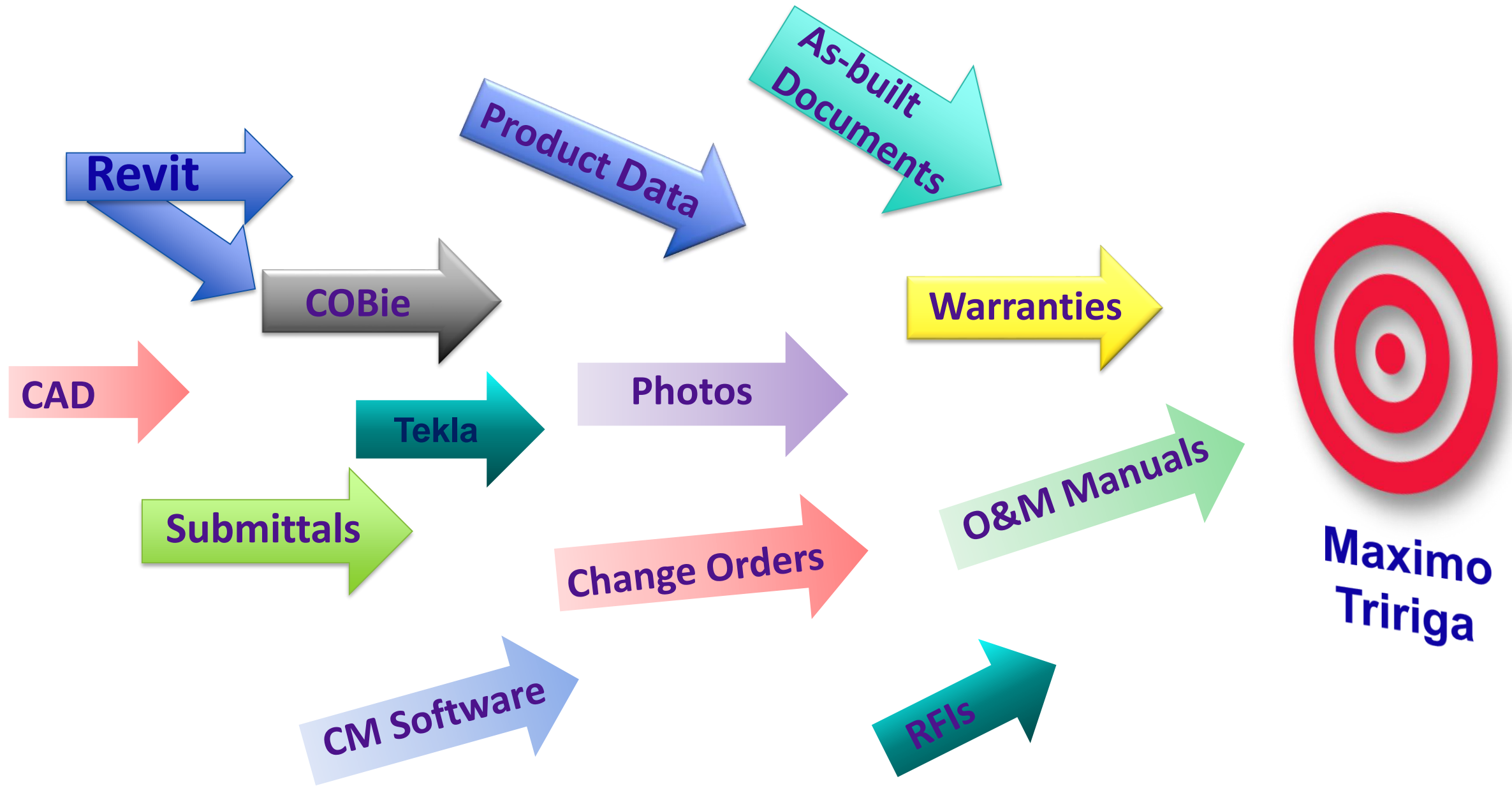
Installation,
Operation, and
Maintenance Manual

Series 1510

Bell & Gossett

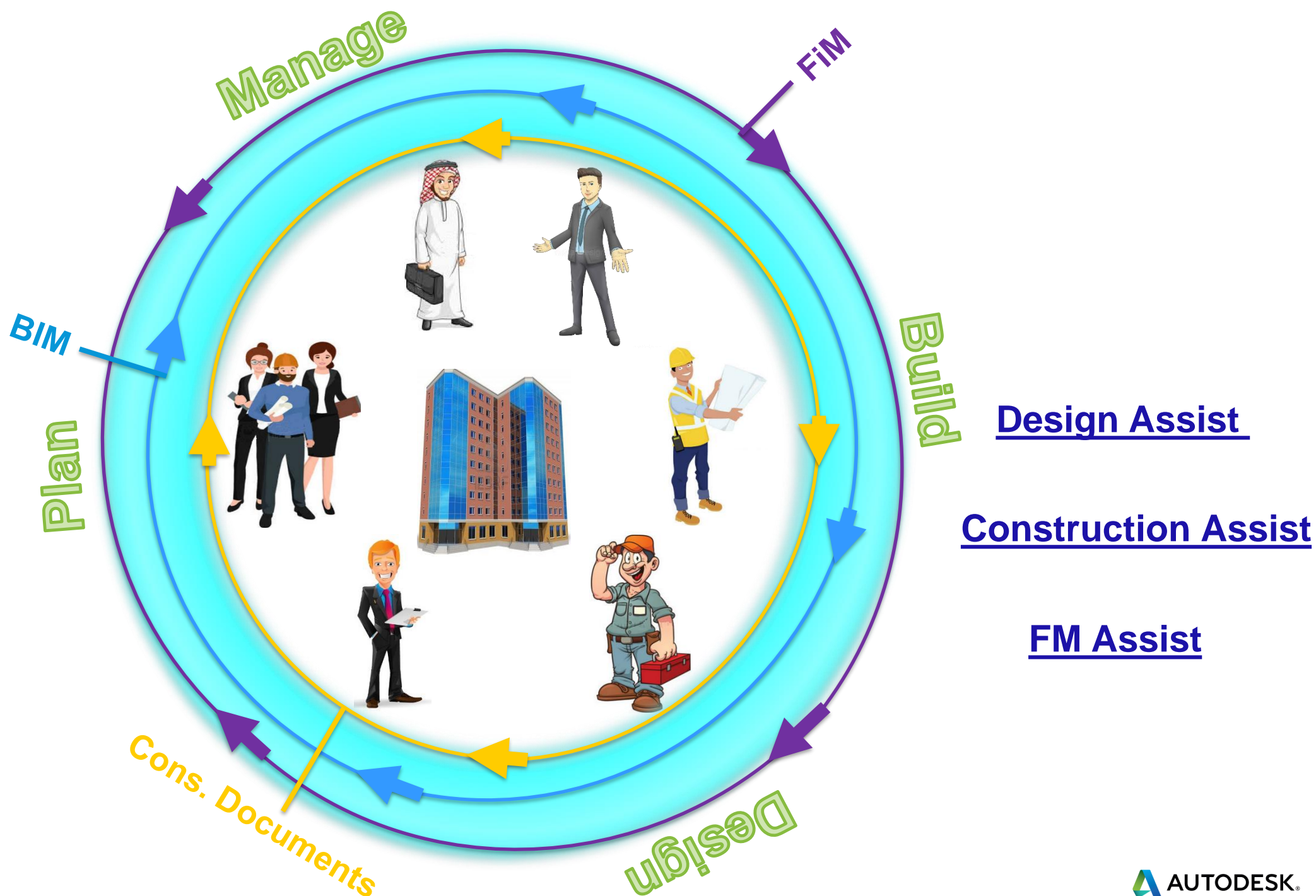
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Documents

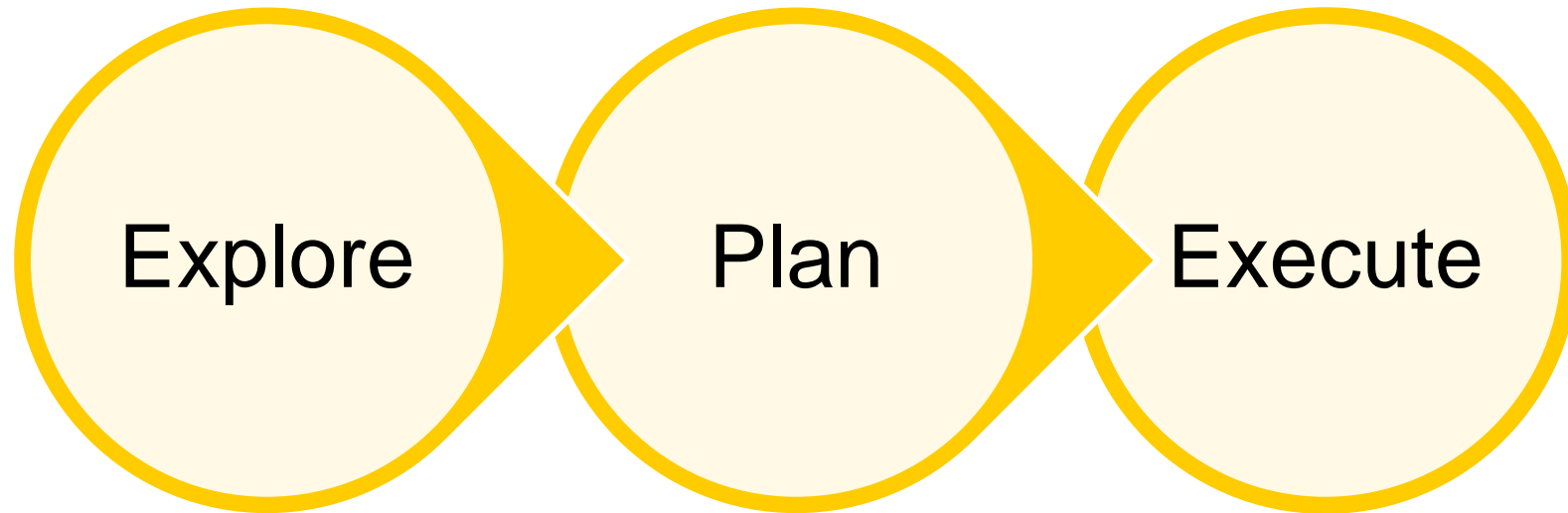


Facility BIM Development Process





BIM to FM Process



Explore

- Is there any **FM software** that an owner is already using, storage location
- What is **current procedure and process** for creating tickets, reviewing documents...
- What **issues** is an owner currently facing
- How many **FM crew** members
- Current **devices** that are in use; Desktop, Tablet, iPad, iPhone
- What **documents** and **attributes** are needed for an owner, FM crew and property manager



Documents and Attributes

Inventory /asset list

Maintenance schedule

Parts replacement list

Equipment that needs regular inspection

Model and serial numbers

Life time expectancy of equipment

O&M, product data, training videos

2D Drawings/Shop Drawings

Service Dept. contact info during and after warranty

Plan

- Meet with **Design Build** (DB) team and get everyone's buy-in
- Create **requirements** for designers and contractors
- Produce **BIM Execution Plan, LOD**
- Compile equipment **schedules** and **asset lists** with trades
- Finalize the list with FM crew and develop **naming convention**



Execute


- Set up BIM 360 **Glue**, **Field** and **Building Ops** projects
- Hold **training** on Building Ops process for entire DB team
- **QC** and **monitor** the model and equipment sets creation
- **QC** and **monitor** as equipment information that is getting populated in 360 filed and Building Ops
- Hold **finale training** with an owner, FM crew, PM and end users

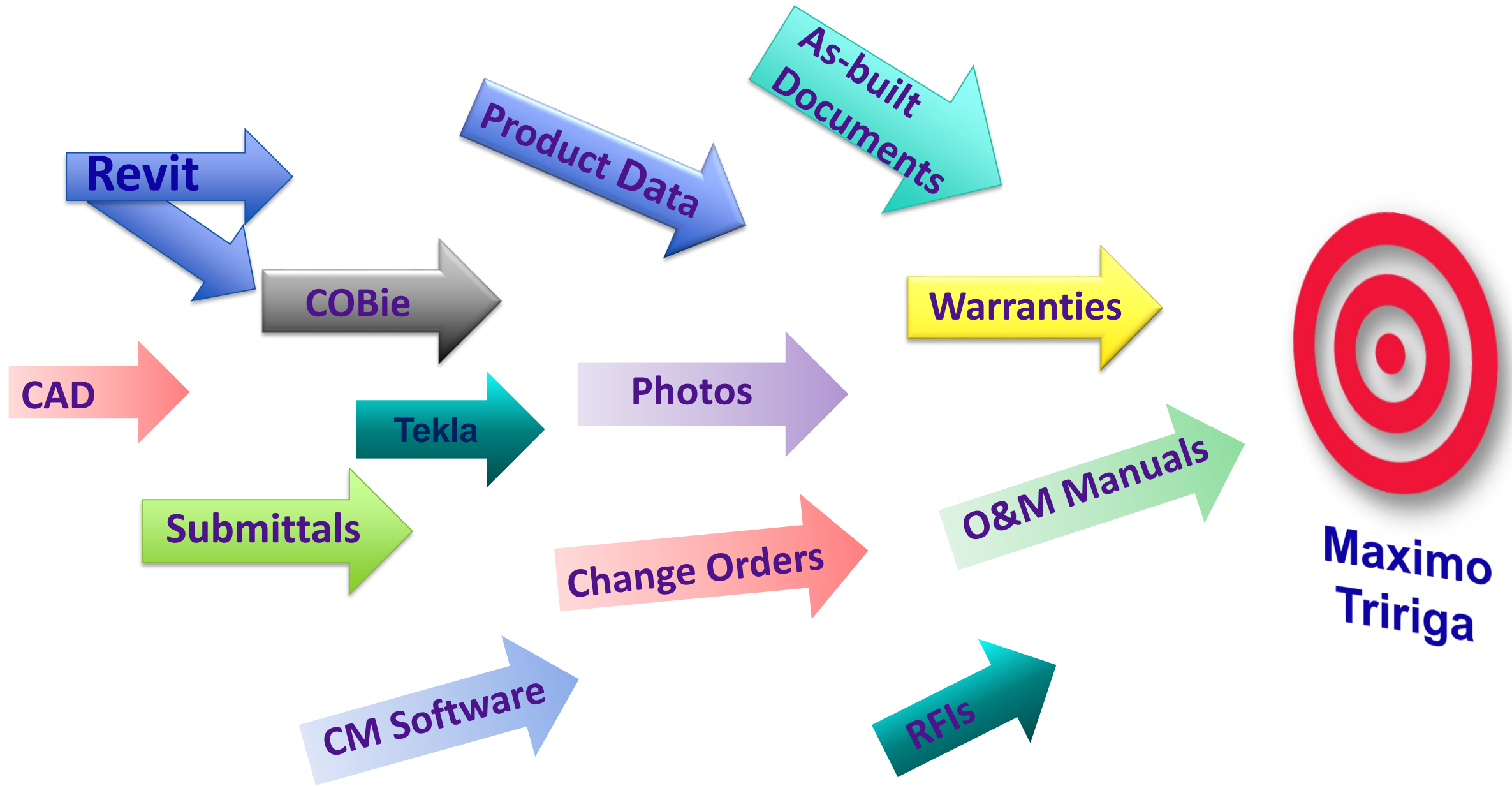
$$\text{Building Success} = \frac{1}{(\text{Cost of Operation}) \times (\text{Equipment Replacement Times})}$$

Using and Capturing Accurate Data
FM Crew Productivity

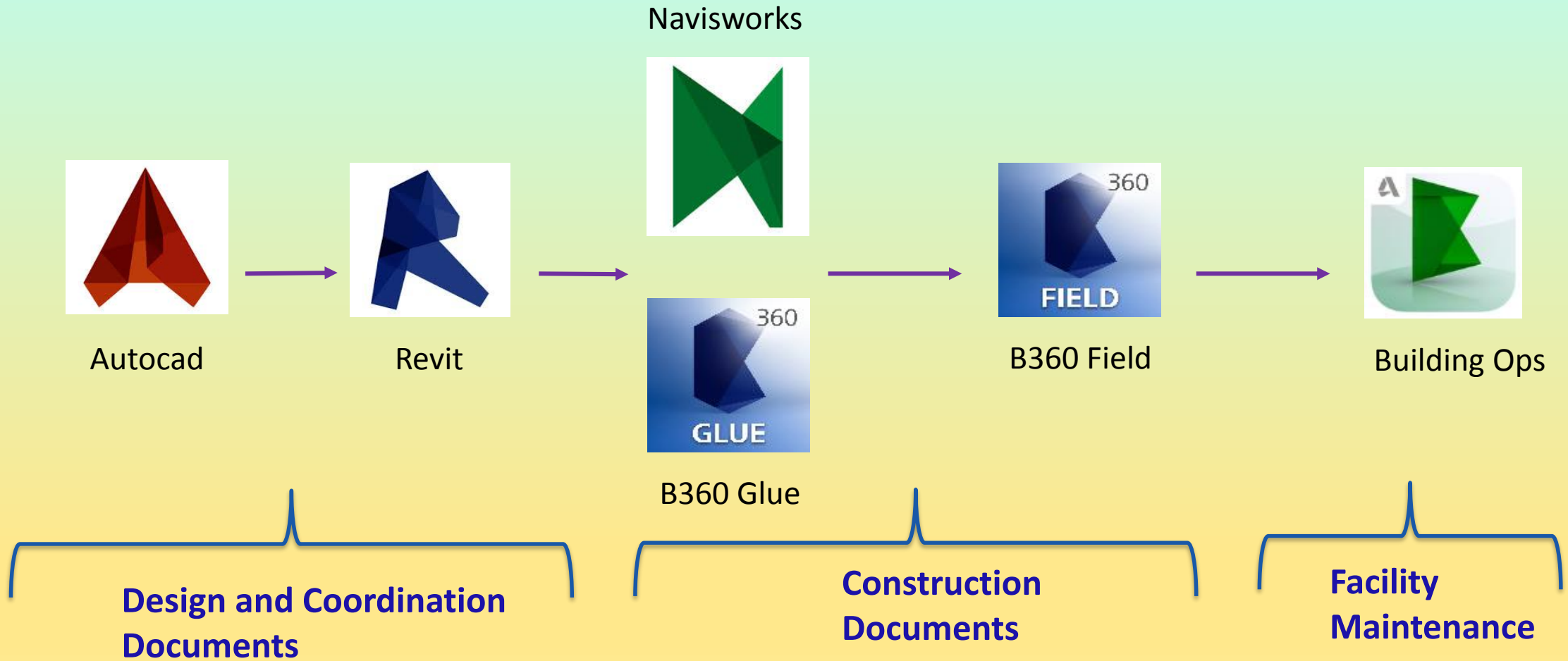


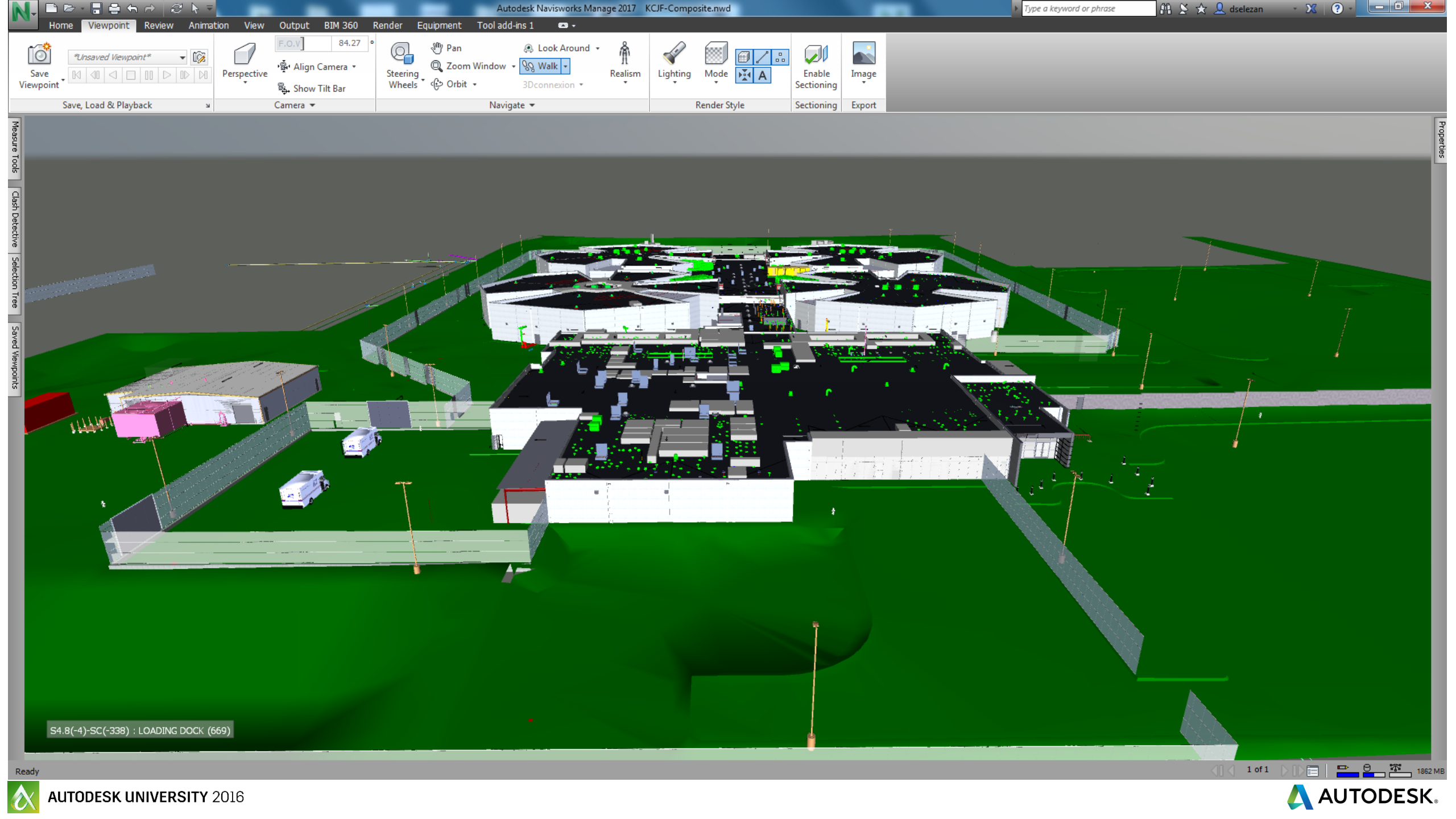
Preventative and Scheduled Maintenance
Quality of Work





Building Ops Process



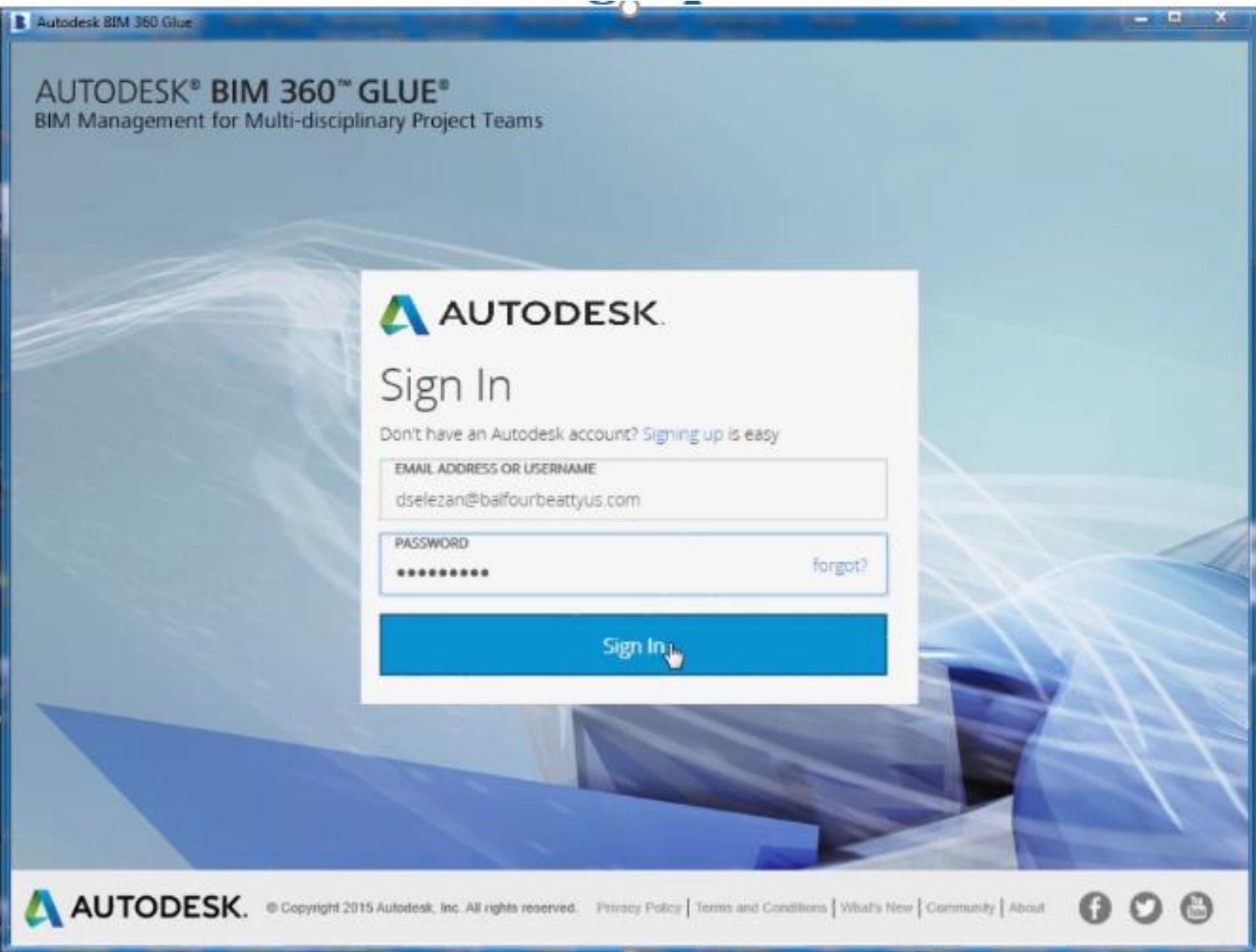


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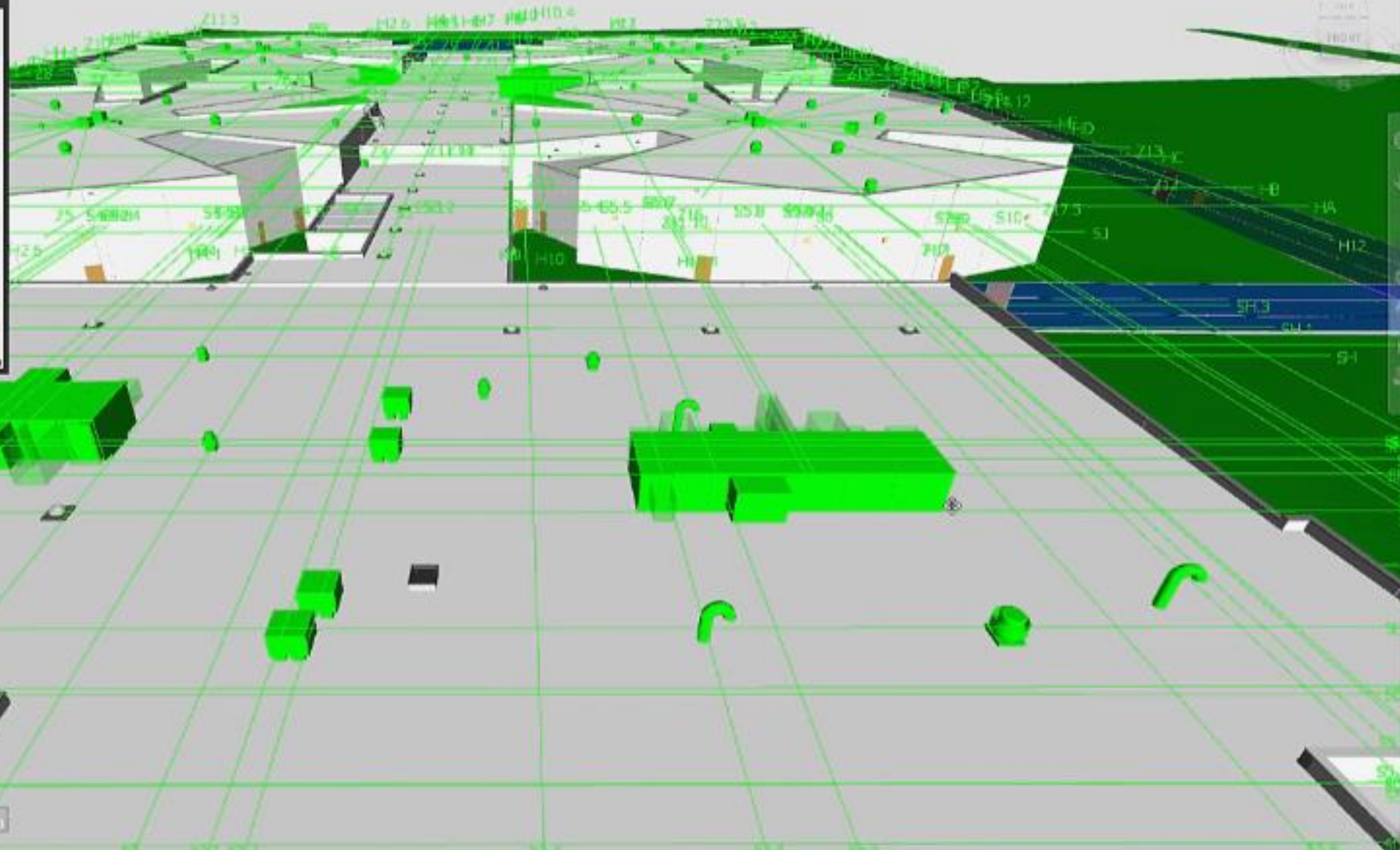
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Models

- CW_Panel_ChainLinkFence1
- CW_Panel_ChainLinkFence1
- CW_Panel_ChainLinkFence1
- CW_Panel_ChainLinkFence1
- CW_Panel_ChainLinkFence1
- CW_Panel_ChainLinkFence1
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- CW_Panel_ChainLinkFence1
- CW_Panel_ChainLinkFence2



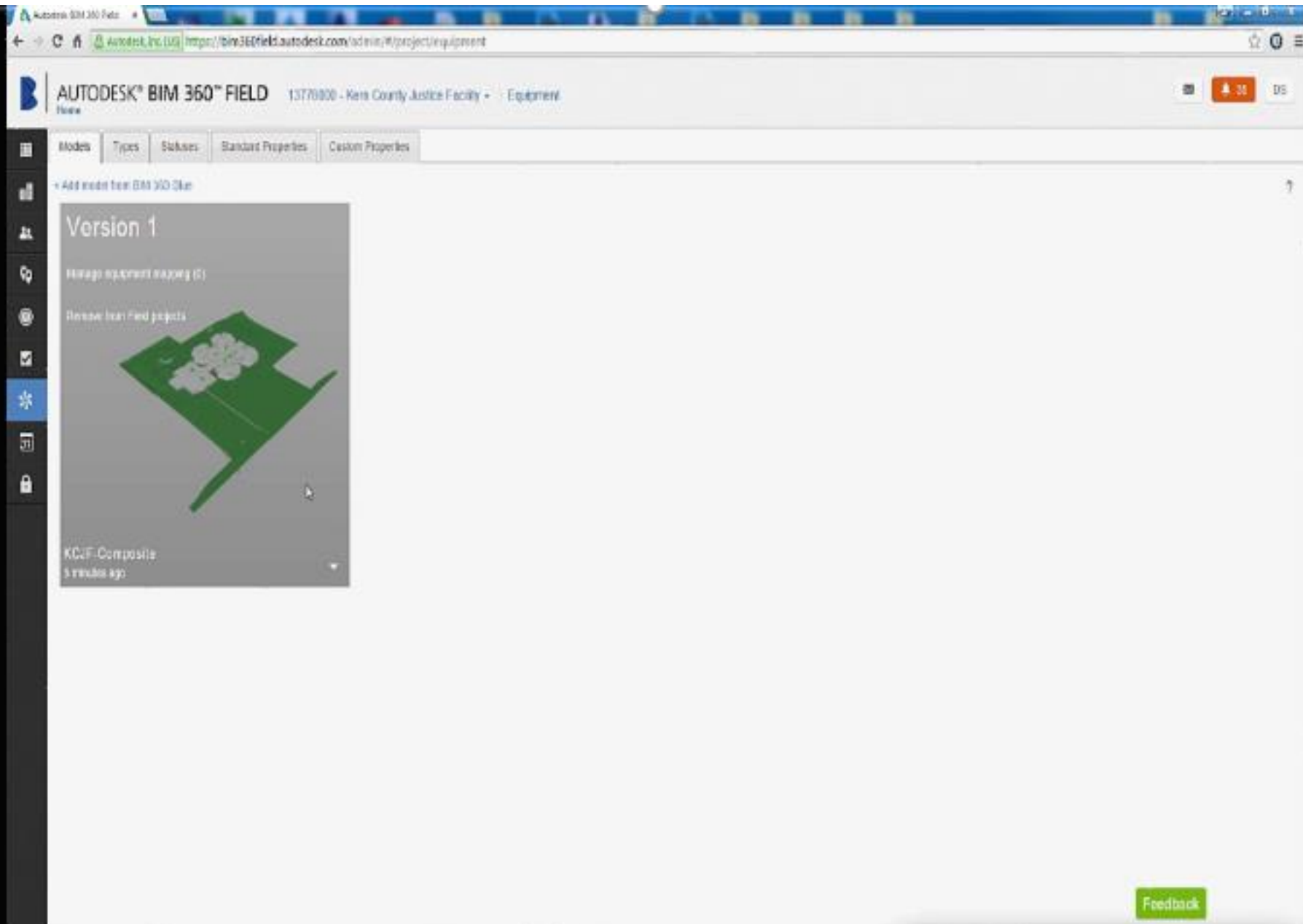
35.30.11-50(1) - 3-02 HWY 13 TO MARSHLY 2473

Models

- Models
- Trane - AHU-6
- Trane-Unit
- Trane - AHU-7
- Trane-Unit
- TRANE - PACKAGED UNIT
- 1" OF MASONRY-H
- KCJF-TTG-EL-Central.rvt
- KCJF-BB-STR_ZoL.rvt
- KCJF-CRIMS-PLBG.dwg

Equipment Sets

Trane-Unit 2	5 Items
Trane-Unit	5 Items



Manage Equipment Mapping

Composite

Select sets

Select type

Select ID and properties

Select equipment properties

	Model objects	Date	
<input type="checkbox"/> Air Handling Units Trane	3	7 days ago	✕

Cancel

Next

Learn

Feedback

Search Equipment Close

☐ Include sub-locations? ☒

Status:

Custom Properties

Delivered Date

From:

To:

Ordered Date

From:

To:

Schedule Required Date

From:

To:

Shipped Date

From:

To:

Advanced Search

Checklists:

Issues:

Open Checklists:

Open Issues:

	Name	Barcode	Type	Description	Location Path	Status	# Issues	# Open Issues	# Checklists	# Open Checklists
<input type="checkbox"/>	FAN EXHAUST 02		Exhaust Fans			Specified	0	0	0	0
<input type="checkbox"/>	FAN EXHAUST 01		Other			Specified	0	0	0	0
<input type="checkbox"/>	PANELBOARD		Other	A SERIES AQ		Specified	0	0	0	0
<input type="checkbox"/>	AC SPLIT UNIT		Other	Panasonic		Specified	0	0	0	0
<input type="checkbox"/>	AHU-1		Other	Trane Roof Top Unit		Ordered	0	0	0	0
<input type="checkbox"/>	FIRE SPRINKLER :		Other			Specified	0	0	0	0
<input type="checkbox"/>	AIR HANDLER		Air Handling Unit			Specified	0	0	0	0
<input type="checkbox"/>	SWITCHBOARD		Distribution Switch	SPECTRA		Specified	0	0	0	0
<input type="checkbox"/>	B3A-RS_SEC.CAM		Distribution Switch	File		Specified	0	0	0	0
<input type="checkbox"/>	Trane 01		Air Handling Unit	[AHU-Rooftop-Carrier- 48HC 15-25 ton_]		Specified	0	0	0	0
<input type="checkbox"/>	M-EQPT		Distribution Switch	Layer		Specified	0	0	0	0
<input type="checkbox"/>	Trane 02		Air Handling Unit	[AHU-Rooftop-Carrier- 48HC 15-25 ton_]		Specified	0	0	0	0
<input type="checkbox"/>	Trane 03		Air Handling Unit	[AHU-Rooftop-Carrier- 48HC 15-25 ton_]		Specified	0	0	0	0

+ Add

✎ Edit

✖ Delete

🖨 Print

⚙ More Actions

Name	Barcode	Type
<input type="checkbox"/> FAN EXHAUST 02		Exhaust Fan
<input type="checkbox"/> FAN EXHAUST 01		Other
<input type="checkbox"/> PANELBOARD		Other
<input type="checkbox"/> AC SPLIT UNIT		Other
<input type="checkbox"/> AHU-1		Other
<input type="checkbox"/> FIRE SPRINKLER :		Other
<input type="checkbox"/> AIR HANDLER		Air Handling Unit
<input type="checkbox"/> SWITCHBOARD		Distribution Switch
<input type="checkbox"/> B3A-RS_SEC.CAM		Distribution Switch
<input type="checkbox"/> Trane 01		Air Handling Unit
<input type="checkbox"/> M-EQPT		Distribution Switch
<input type="checkbox"/> Trane 02		Air Handling Unit
<input type="checkbox"/> Trane 03		Air Handling Unit

Export equipment to Autodesk Building Ops




Enter your export code from the Building Information Page in Autodesk Building Ops

Done

[illegible]



All Buildings

all open 19	new 9	upcoming 0	overdue 18
needs attention 2	completed 1	closed	add building +
all assets 	all contacts 	all inspections 0	all checklists 0
settings 			

[Contact Us](#)

Name ^

status [Commissioned](#) >

[Contact Us](#)

2015 Product Warranties

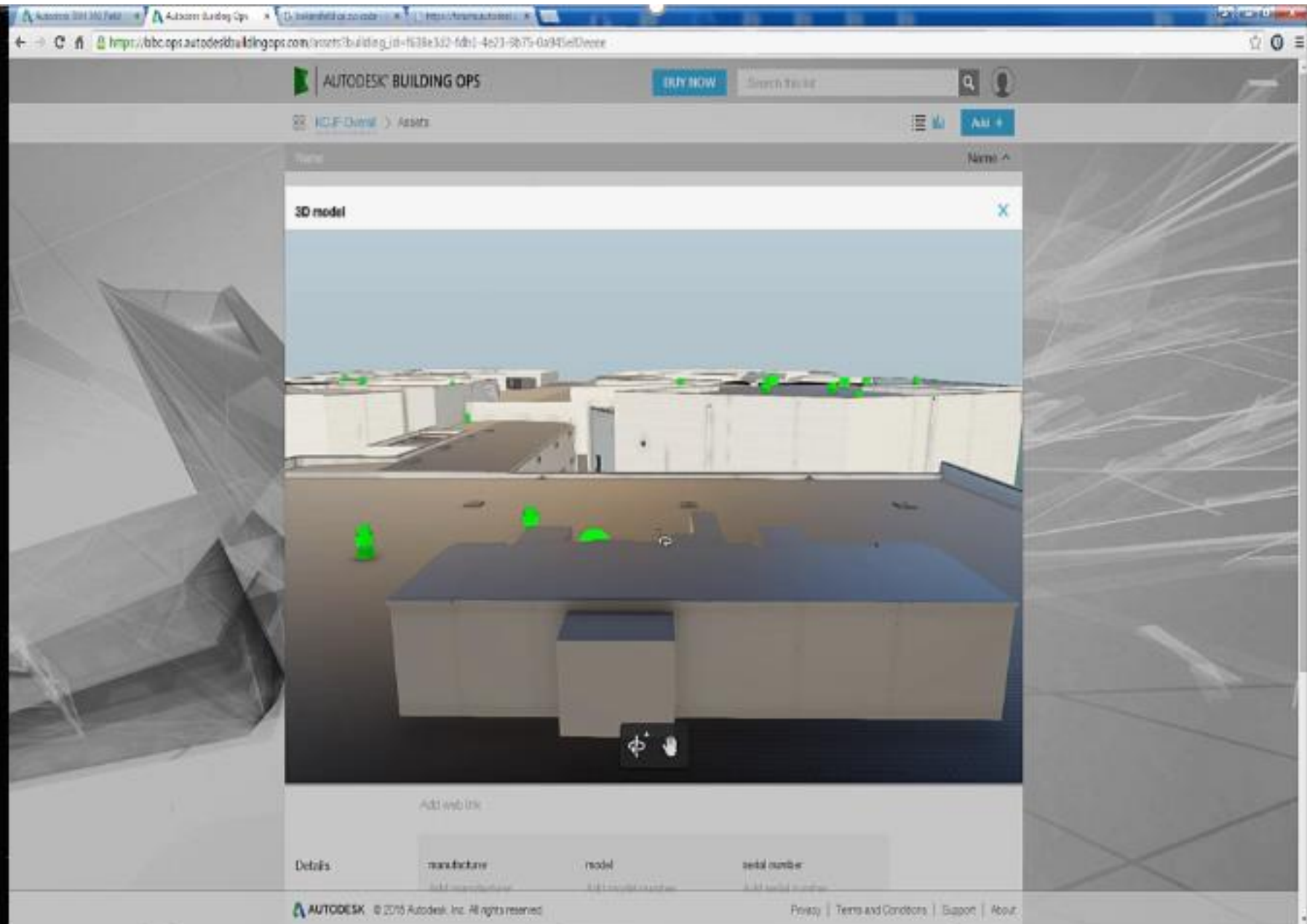


It starts at trane.com









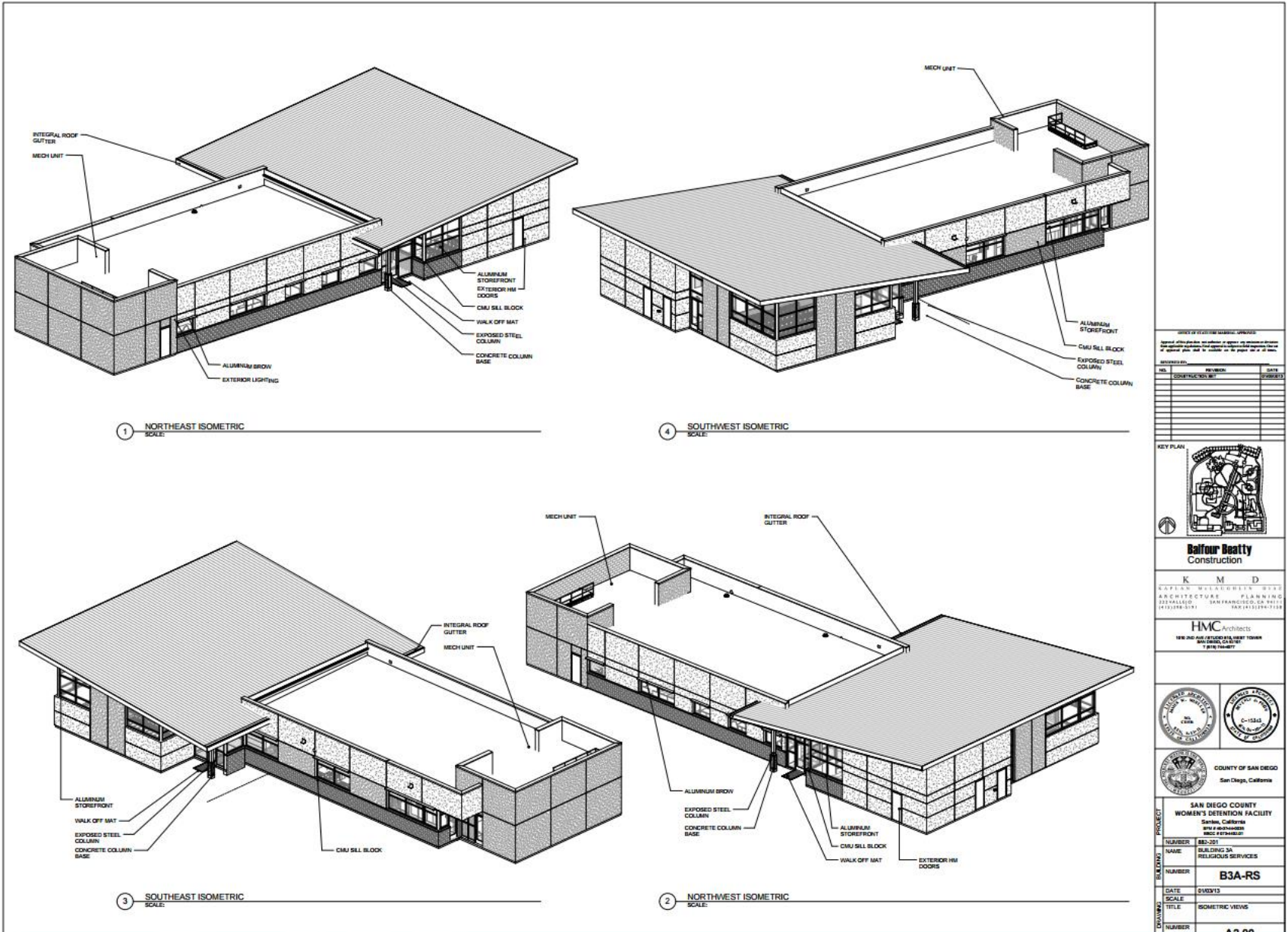
Add PDF



Contact Us

Next Sheet

Previous Sheet





portfolio web link

portfolio owner

co-owners

Zane >

Rudy Armendariz >

buildings in this portfolio

tickets

20 tickets in 4 buildings



assets

141 assets in 4 buildings

contacts

8 contacts, 4 occupants

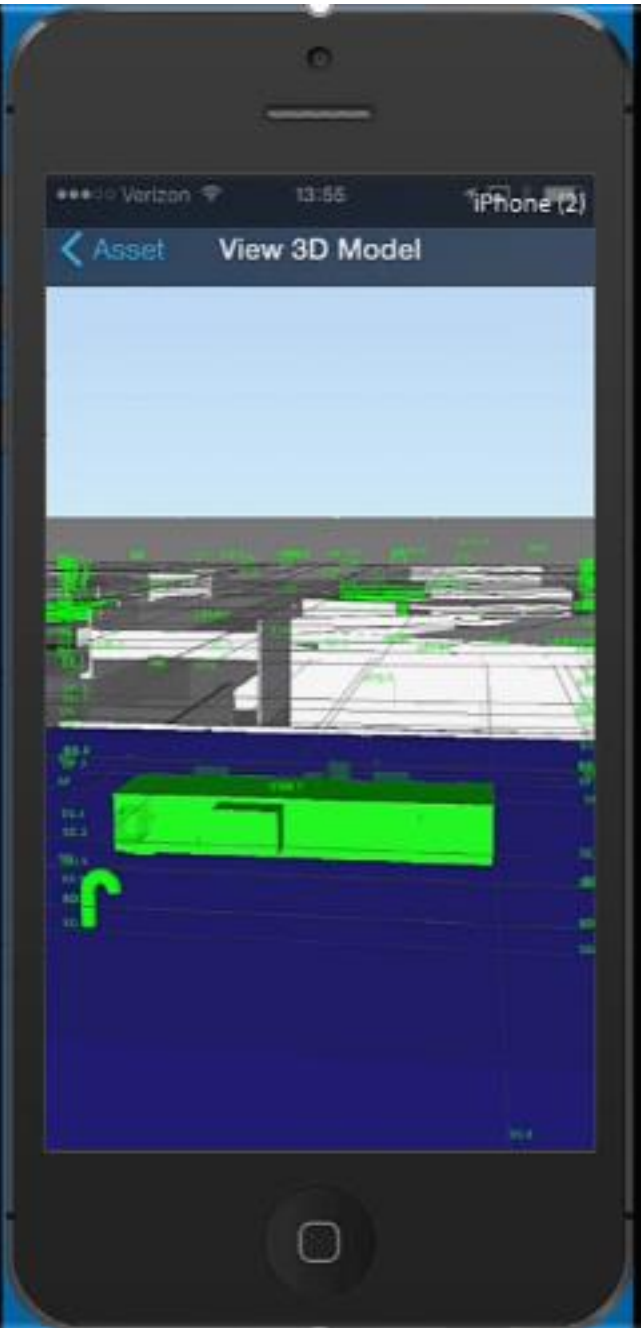


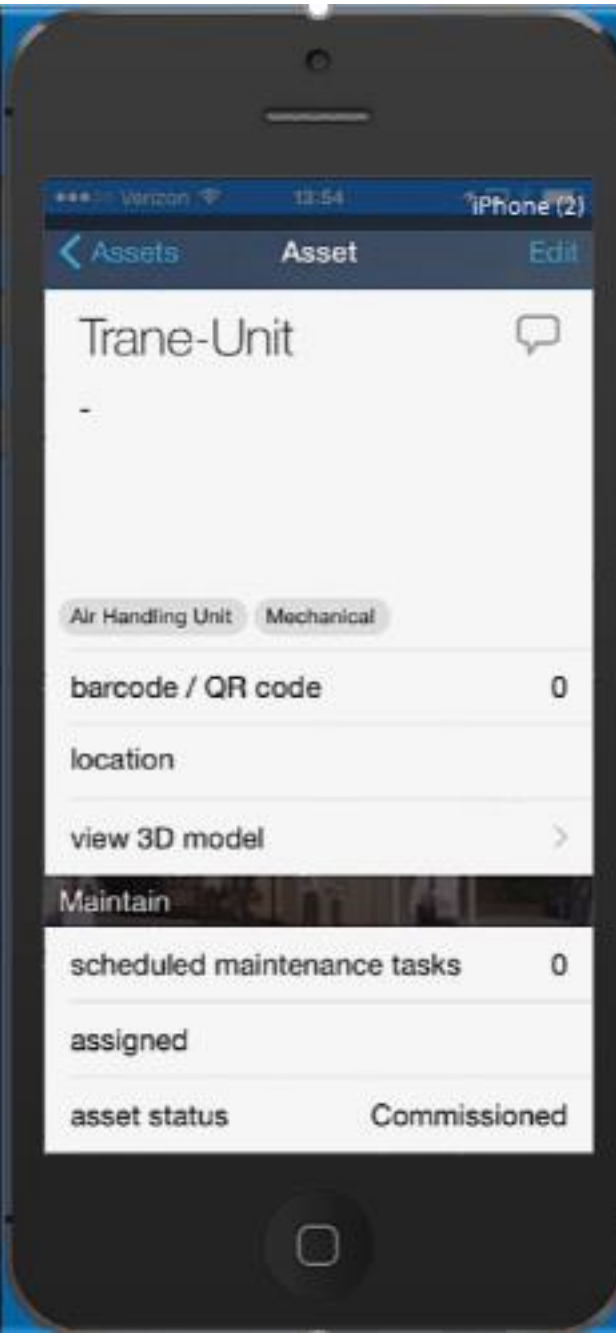
occupants can join from

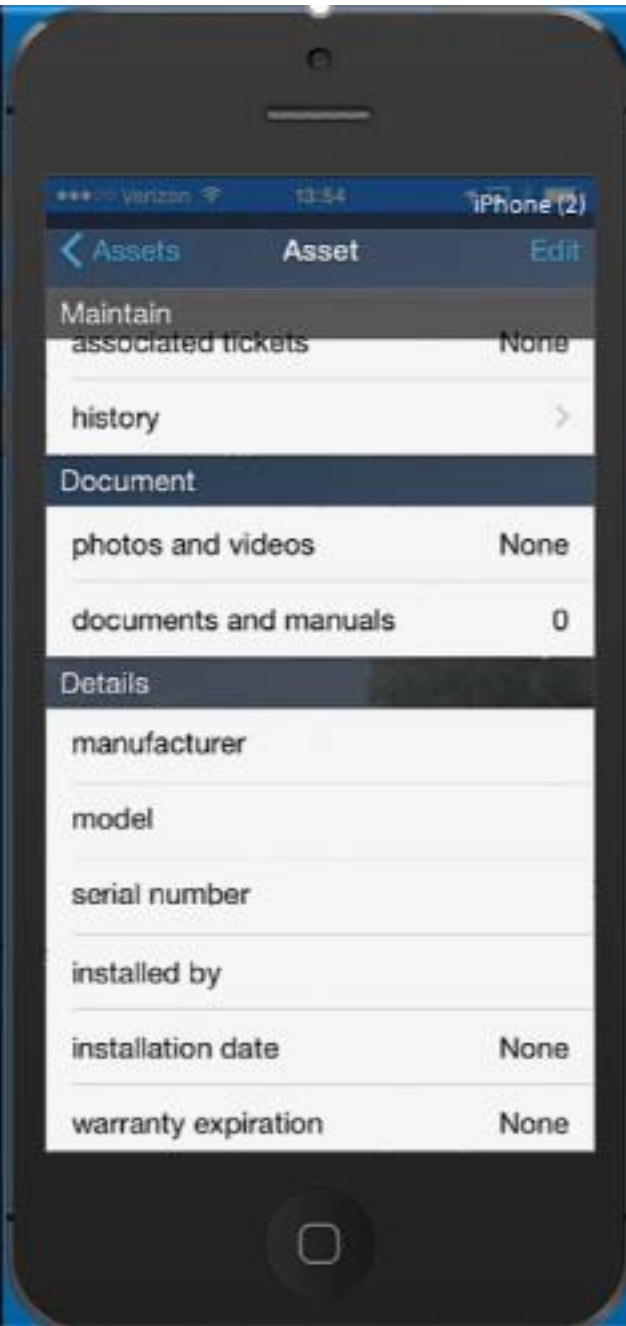
Contact Us

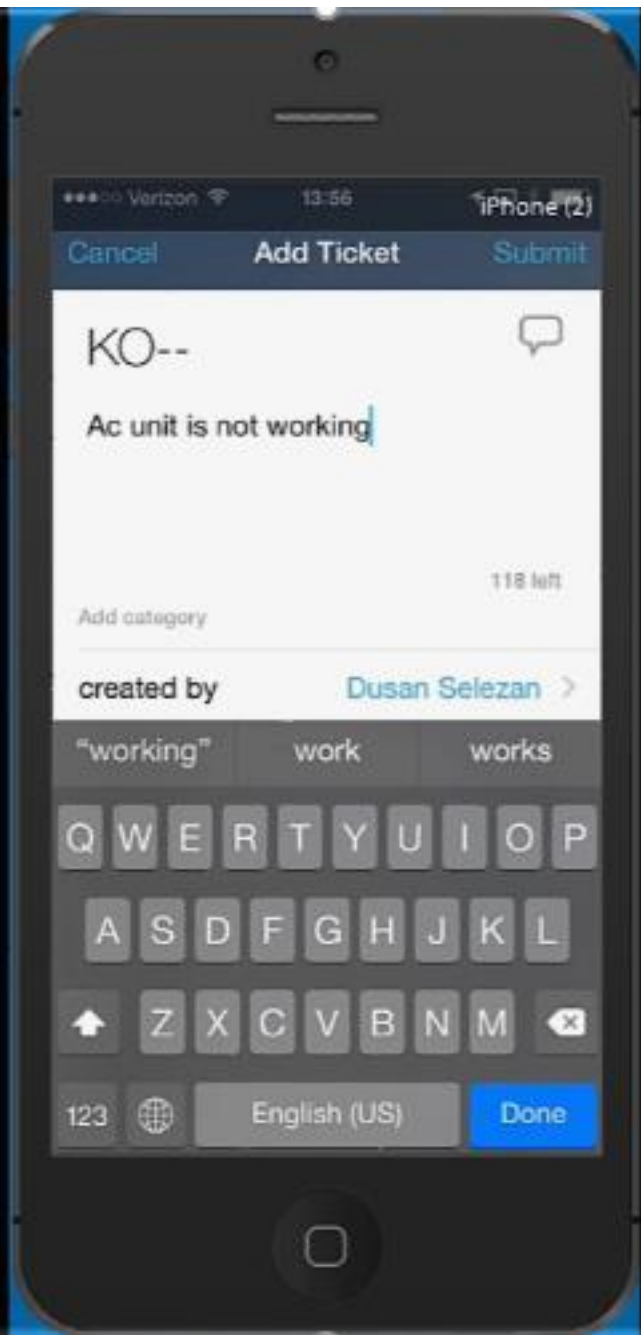


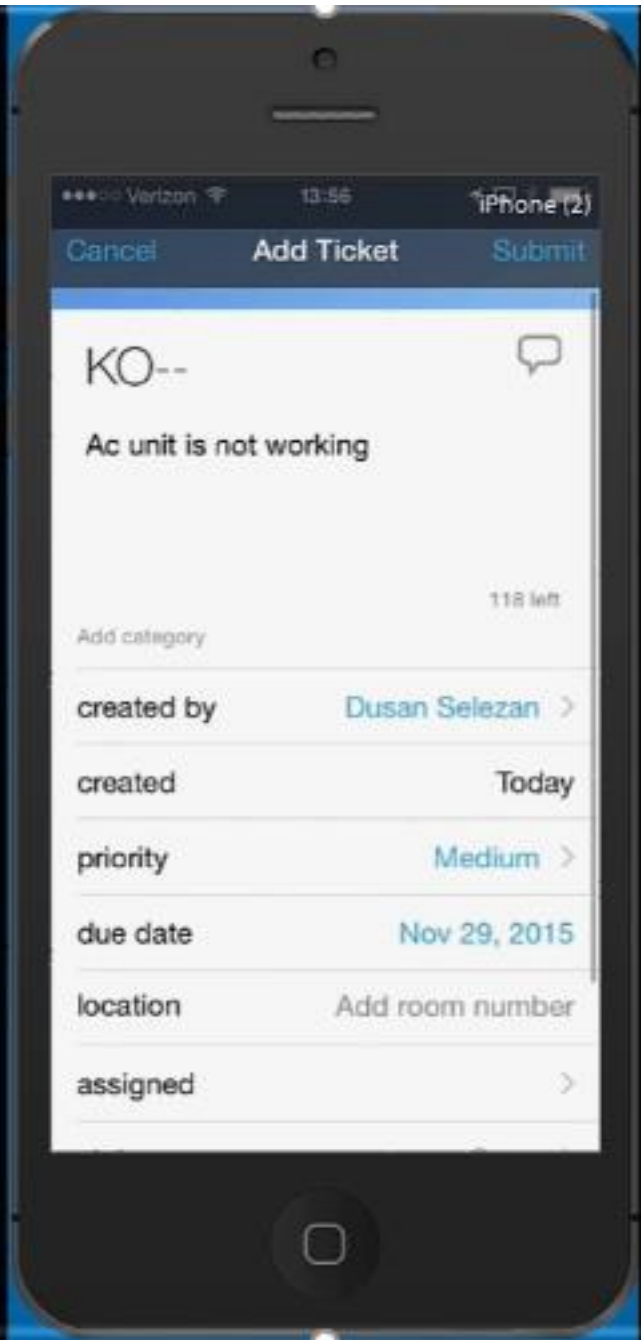


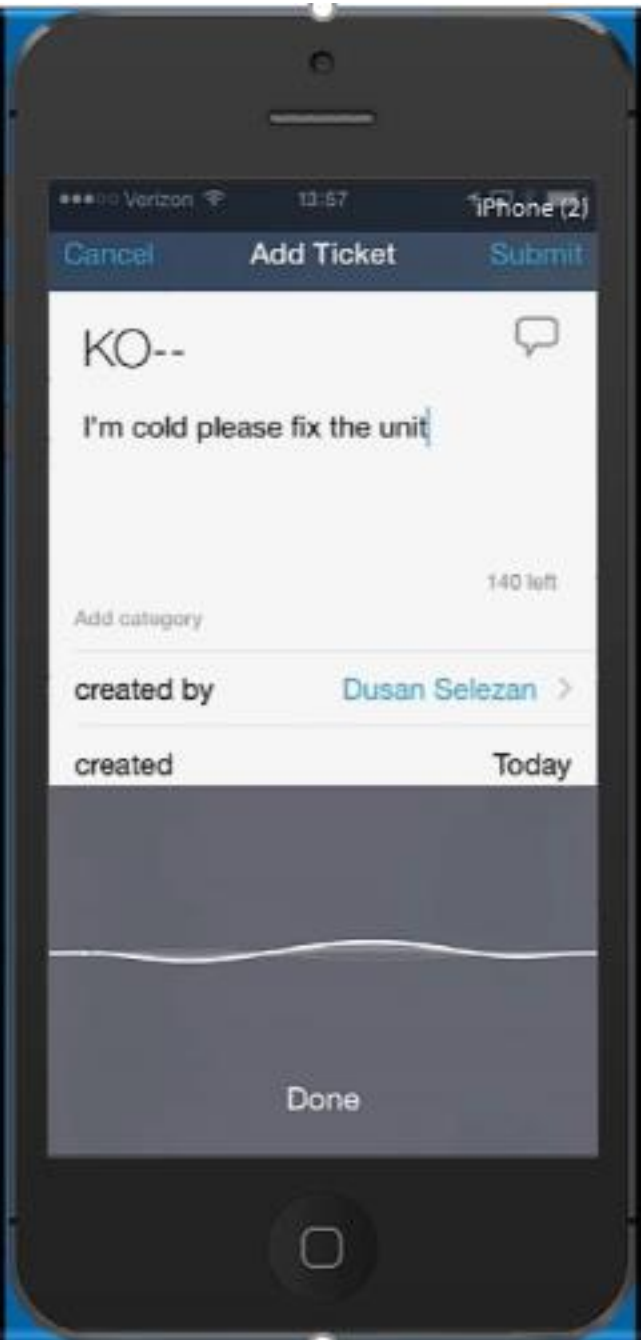


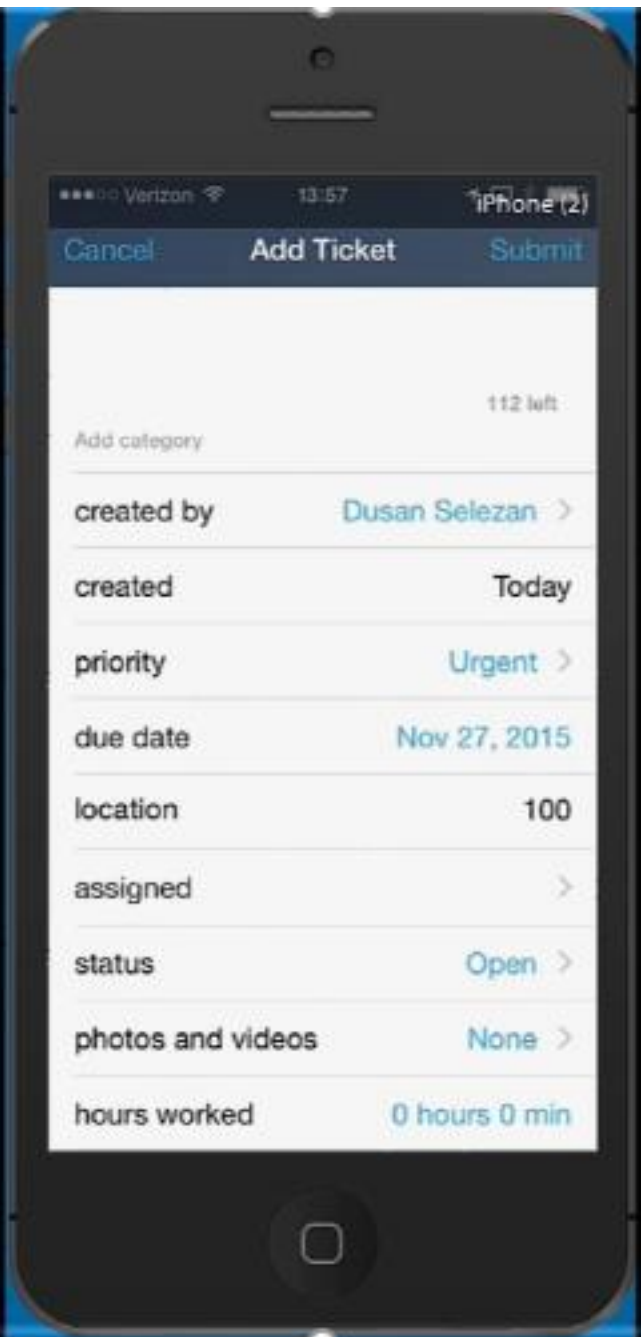












Best Suited Project/Facility Type for Building Ops



Educational



Medical Clinics



Hospitality



Criminal Justice

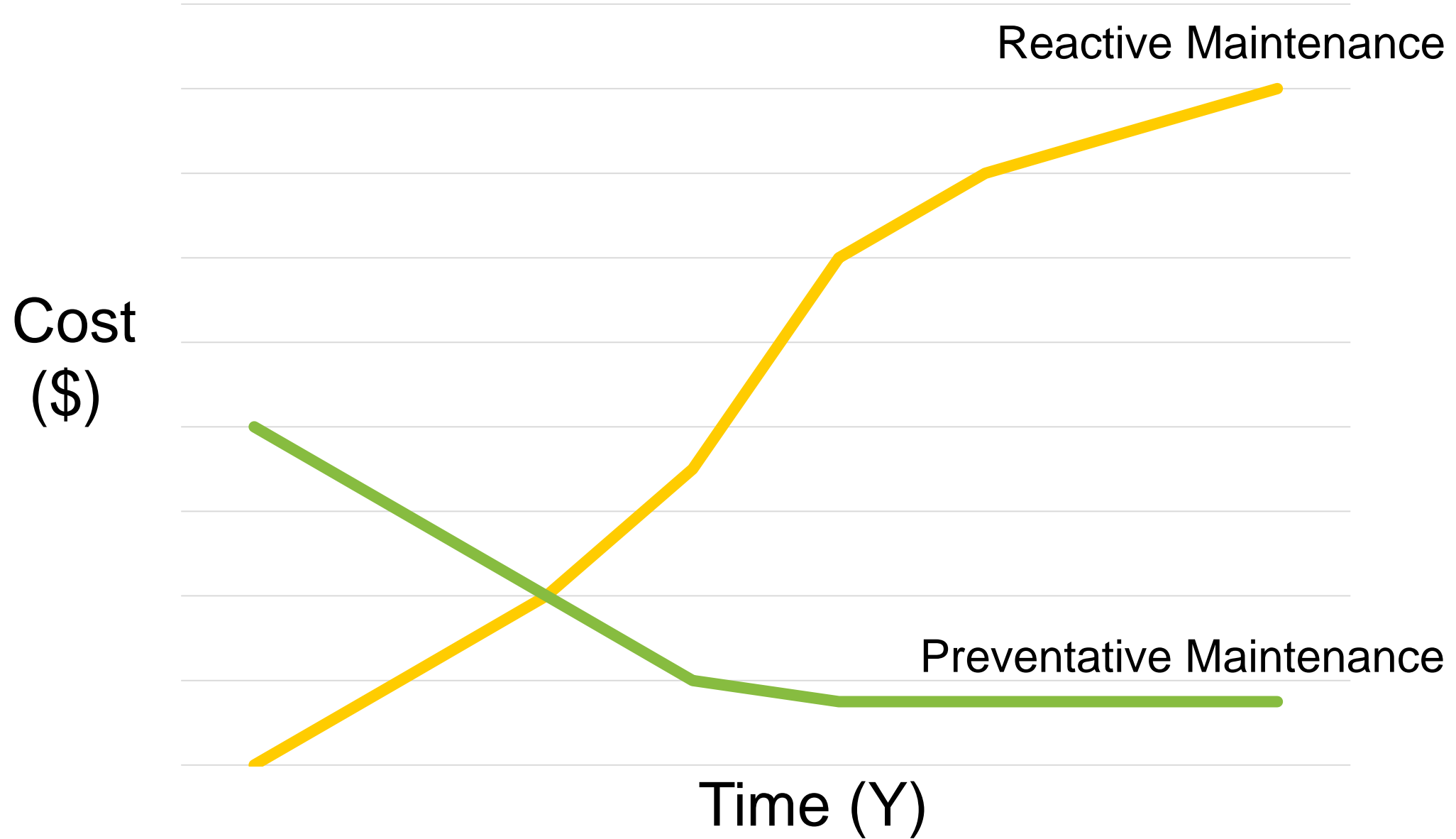


Residential



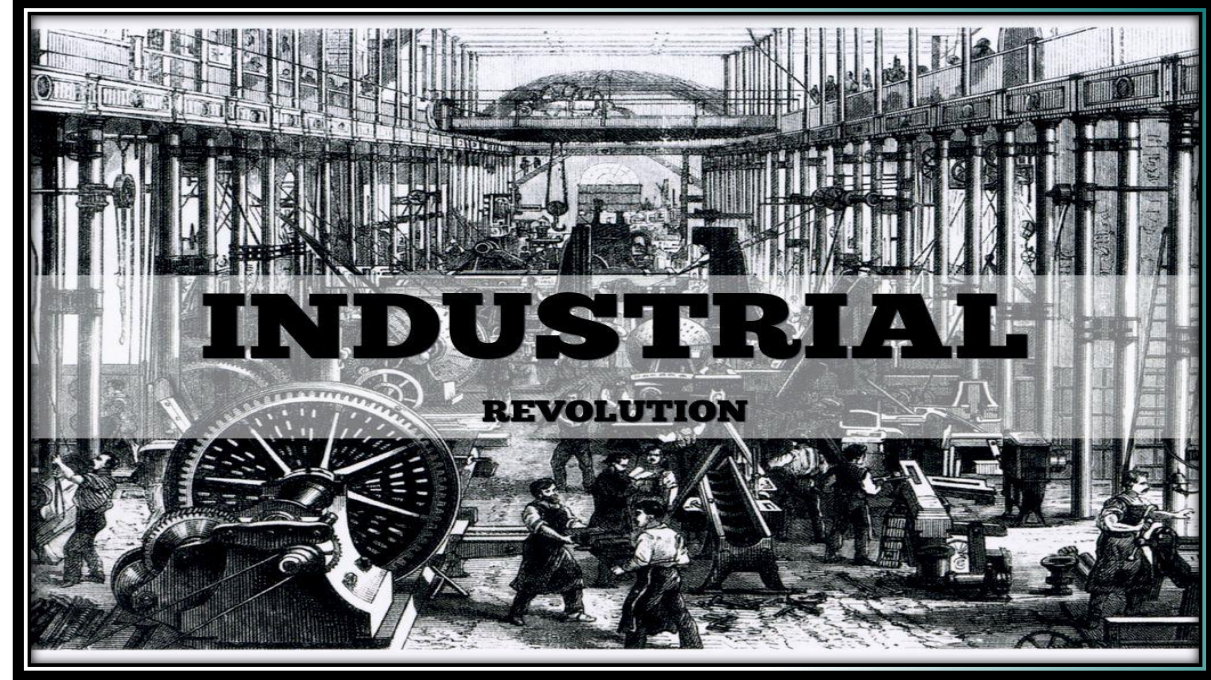
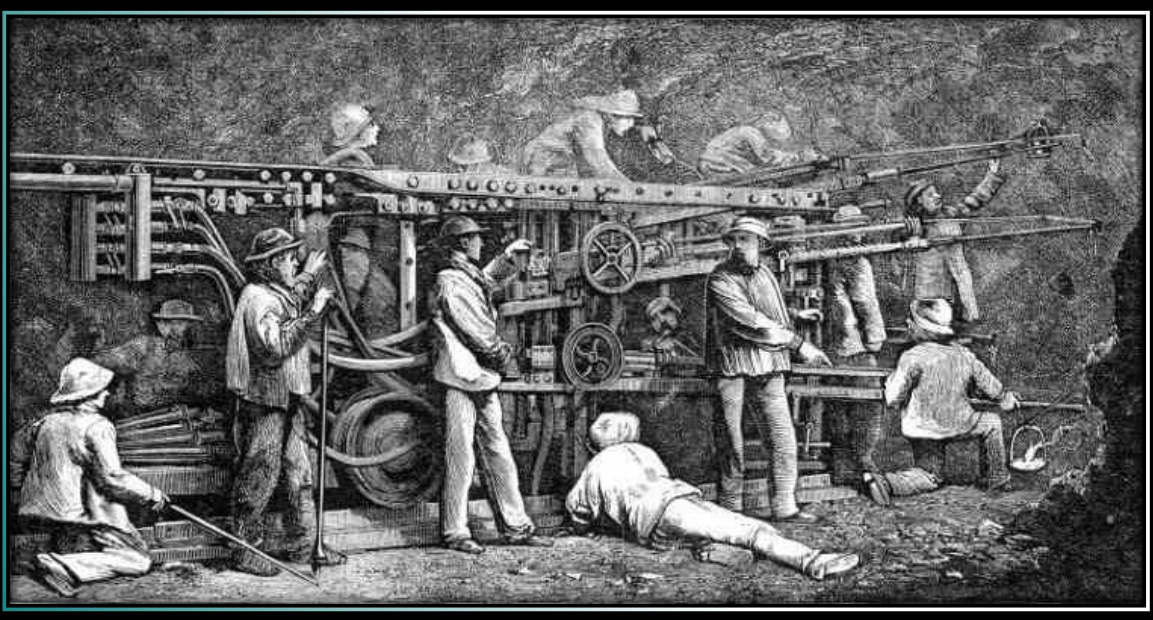
Industrial

Cash Flow Chart



Negative Effects:

- Machines Replaced Handicraftsmen
- Loss of Jobs
- **Loss of Jobs**

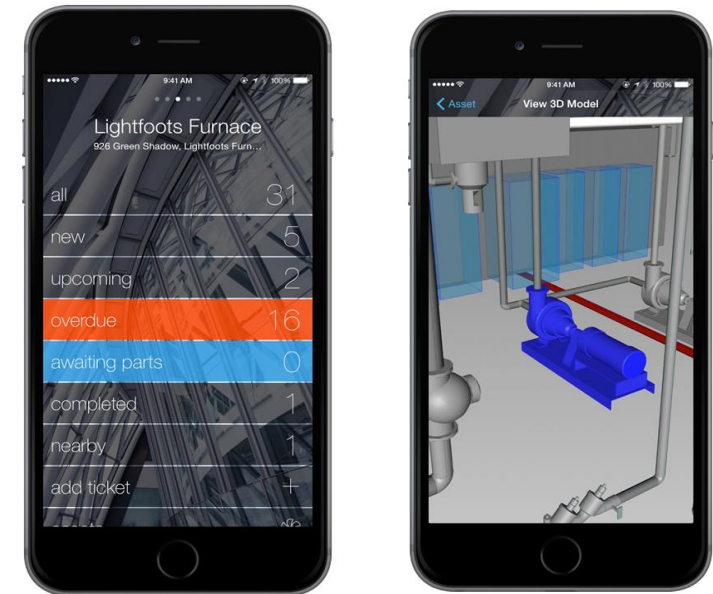


Positive Effects:

- Improved Peoples Daily Lives
- Increased Production and Productivity
- It expanded Educational Opportunities
- Encouraged Invention and Technology

The Value for Building Owners

- Begins operations on day one
- Provides more mobility to workers, information is cloud based and mobile device accessible
- Helps FM crew better understand the building components by viewing in 3D and having documents linked
- Increases occupant satisfaction by more effectively communicating with them about their maintenance issues
- Uses accumulated repair data to implement intelligent, predictive maintenance schedules
- Improves productivity and saves resources



Optimize the efficiency of the facility maintenance process

- Set up the process early
- Define information that is needed
- Help develop owner requirements
- Include FM crew in a design process
- Who's models to us; Who collects data; Who performs QC?

Vehicle Sensors

25 sensors

Lane departure system

Night vision

Front object CCD camera

Front airbag sensors

ASCD

Nighttime pedestrian warning

Drowsiness sensors

Front object laser radar

Nighttime pedestrian warning IR sensor

Active park assist

Tire pressure sensor

Rear object monitor CCD camera

Rear camera

Side curtain sensor

Blind spot detection

Cross traffic alert

Central computer

Rear object laser radar

Wheel speed sensor

Tire pressure sensor

Collision sensor

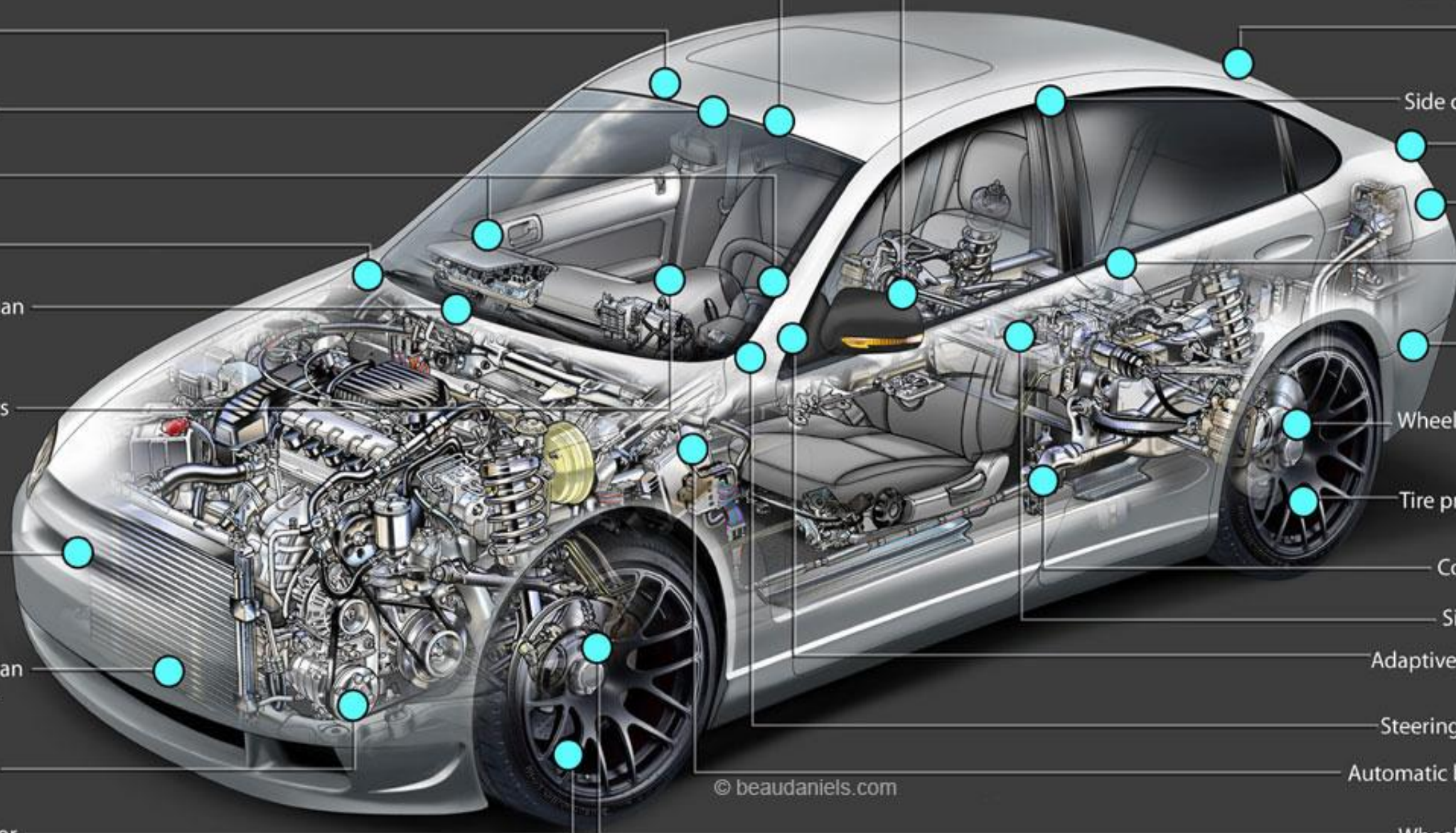
Side airbag SRS

Adaptive cruise control

Steering Angle sensor

Automatic brake actuator

Wheel speed sensor



© beaudaniels.com

Cost \$30,000

0 sensors



Cost \$30,000,000



Future Development

- Future integration with building automation systems
- Bi-direction data exchange
- Navisworks add-in
- Customizable asset columns





How did We do?

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- AU speakers will get feedback in real-time.
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