# FCA, Commissioning, Recommissioning and Retro-Commissioning:

## *Which One Do I Need and Why?*


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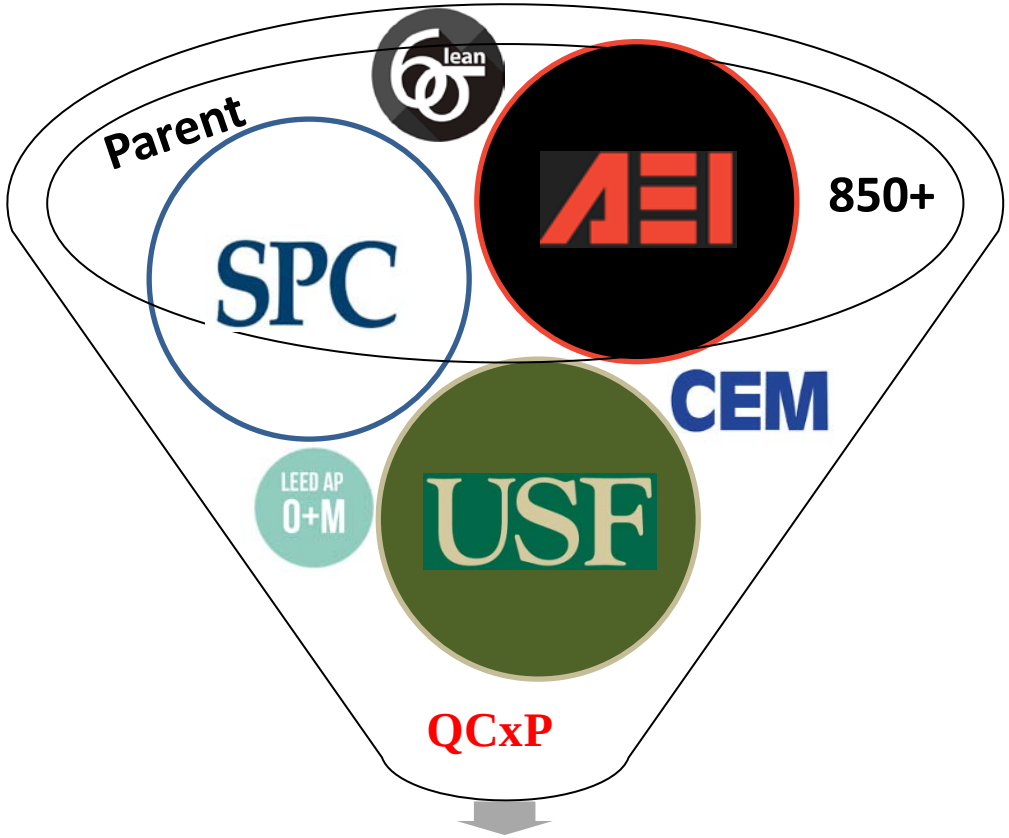
FEFPA

# Who am I?




Who?

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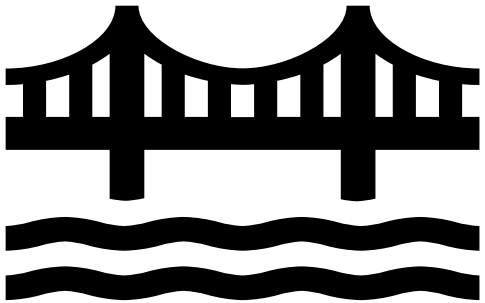
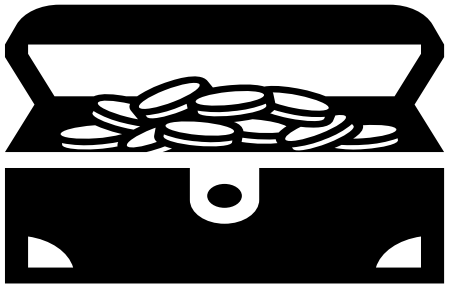
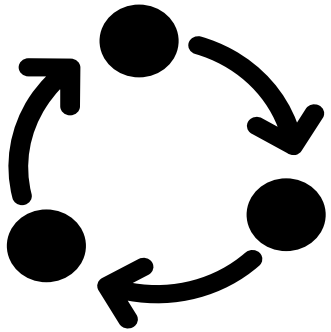
# Why am I here?



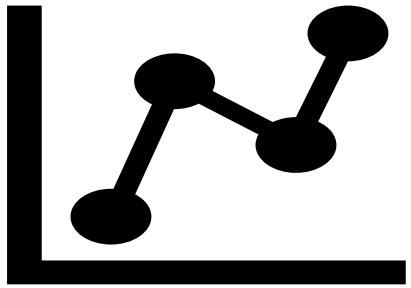
Bridge the Gap
between FCA, Cx & FP



Convey the diverse
benefits of FCAs & Cx



Share best FCA & Cx
application practices



Explore FCA and Cx
Data and findings

Why?

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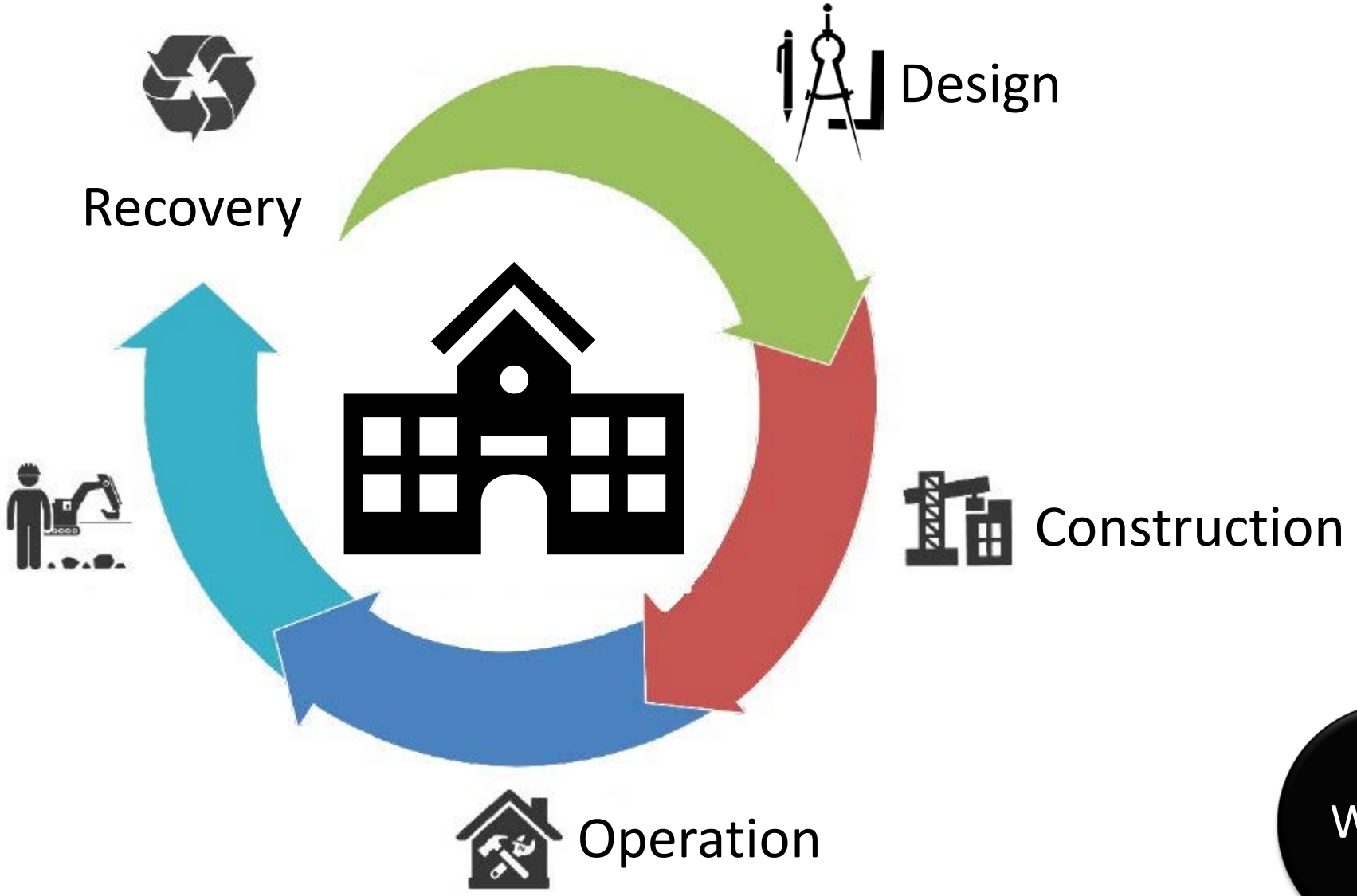
# Big Picture - Facility Lifecycle




What?

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# Cx and FCA Integration

FCA

Cx

When?

New Construction Commissioning

Re-commissioning

Ongoing Commissioning

Retro-commissioning

Fundamental Commissioning

# COMMISSIONING (Cx)

Enhanced Commissioning

Monitoring-based Commissioning

Code Compliant Cx

Continuous Commissioning

## Why all the confusion?

What?

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# Cx Origins – Ship Building

History Lesson:

- Before Cx, Captain *sailed the harbor*
- *Test Drive* approach changed in 1775
- *Alfred*, 1st ship of Continental Navy
- Cx ceremony became a Navy tradition

Ship Cx Attributes:

- "Quality assurance process"
- Installing and testing equipment
- Identifying and correcting problems
- Training the prospective crew

What?

# Cx Origins – 200 Years later…

**1977**

**Public Works of Canada** adopt Commissioning in their Project Delivery System

**1981**

**Walt Disney** included Commissioning in the Design, Construction and Start Up of the **Epcot Centre, Florida**

**1984**

The **University of Michigan** establishes a Facilities, Evaluation and Commissioning Group

The **Commissioning Guideline Committee** was formed by ASHRAE

The **University of Wisconsin**, Madison create Commissioning Courses

**1989**

First ASHRAE **Commissioning Guideline is Issued**

What?

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# Cx Origins – And Here We Are

**1993**

First National Conference on Building Commissioning held [NCBC]

National Environmental Balancing Bureau [NEBB] develop Certification Programme

**1998**

**US Green Building Council adds Commissioning** to the LEED Programme

**1999**

Building Commissioning Association [BCxA] Established

**2010**

**California introduces mandatory Commissioning** requirements for Buildings

**2017**

**Commissioning required per FBC Section C408,** Energy Conservation

What?

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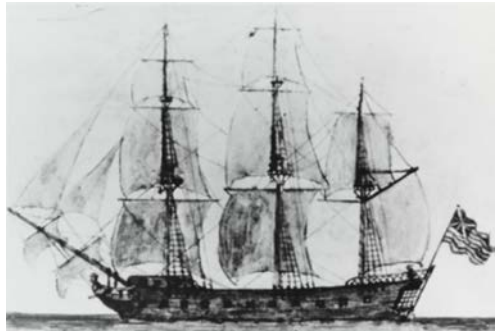
# Cx Defined

Per ASHRAE Guideline 0: Commissioning is a quality-focused process for enhancing the delivery of a project. The process focuses on verifying and documenting that the facility and all its systems and assemblies are planned, designed, installed, tested, operated, and maintained to meet the Owner's Project Requirements.



Ship Cx Attributes:

- "Quality assurance process"
- Installing and testing equipment
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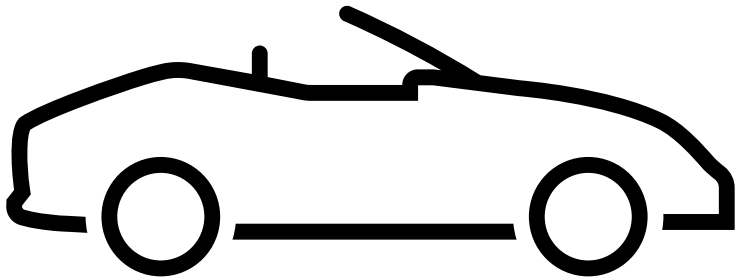
What?

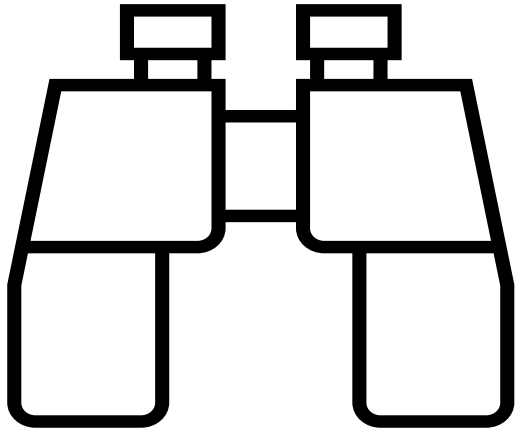
# Cx *Anal*ogies

## Owner



"It's like paying someone to test-drive your new car"

## Contractor



"It's like a colonoscopy for your building, and they get up there!"

What?

New Construction Commissioning

Re-commissioning

Ongoing Commissioning

Retro-commissioning

Fundamental Commissioning

# COMMISSIONING (Cx)

Enhanced Commissioning

Monitoring-based Commissioning

Code Compliant Cx

Continuous Commissioning

**Let's clean this up!**

What?

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# New Construction Commissioning (NCCx)

COMMUNICATIONS

Common Systems

HVAC

LIGHTING

ELECTRICAL

PLUMBING

SECURITY

FIRE ALARM

AUDIO/VISUAL

BUILDING ENVELOPE

ASHRAE Phases

PRE-DESIGN

DESIGN

CONSTRUCTION

OCCUPANCY

What?

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SEPARATE CONTROL ENVIRONMENTS

# NCCx Process Scope Options

| | FL Building Code Requirement | LEED (Fundamental / Required) | LEED (Enhanced) | ASHRAE 0 |
|---|---|---|---|---|
| Review Design, OPR, BOD and Issue Review | - | YES | - | YES |
| Prepare Commissioning Plan | YES | YES | - | YES |
| Monitor Construction / Equipment Install | YES | YES | - | YES |
| Review Testing Reports (e.g TAB) | YES | YES | - | YES |
| Prepare Pre-Functional Checklists | YES | YES | - | YES |
| Perform Functional Performance Testing | YES | YES | - | YES |
| Prepare Preliminary Commissioning Report | YES | YES | - | YES |
| Prepare Final Commissioning Report | YES | YES | - | YES |
| Coordinate / Review Oper. & Maint. Manuals | YES | YES | - | YES |
| Prepare LEED Documentation | - | YES | YES | - |
| Review Contractor Submittals | - | - | YES | YES |
| Verify Systems Manual Updates and Delivery | YES | - | YES | YES |
| Verify Owner and Occupant Training at Occupancy | - | - | YES | YES |
| Review Bldg. Operations at 10-month Post- Occupancy | - | - | YES | YES |
| Develop Ongoing Commissioning Plan for Occupancy | - | - | YES | YES |

What?

# Minimum Cx Scope, per FBC

The Florida Building Code (FBC) requires Commissioning of the following systems:

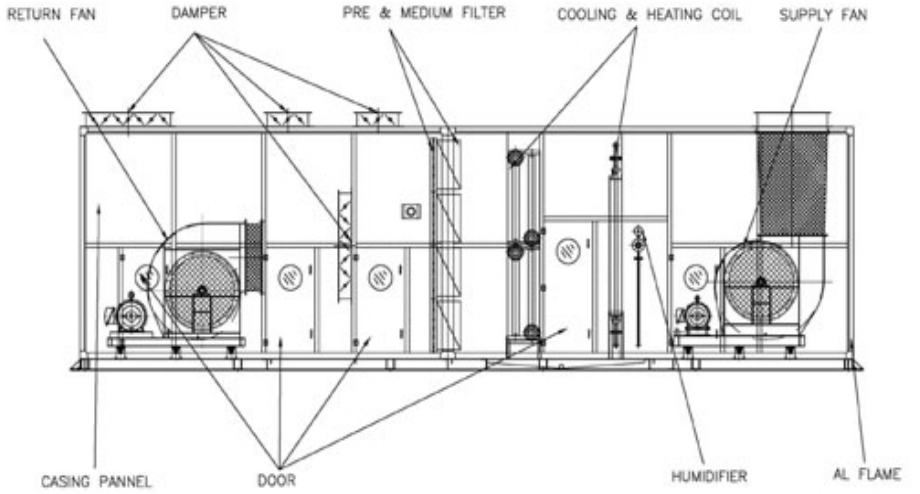
- Mechanical systems
- Electrical power systems
- Lighting systems
- Air distribution systems

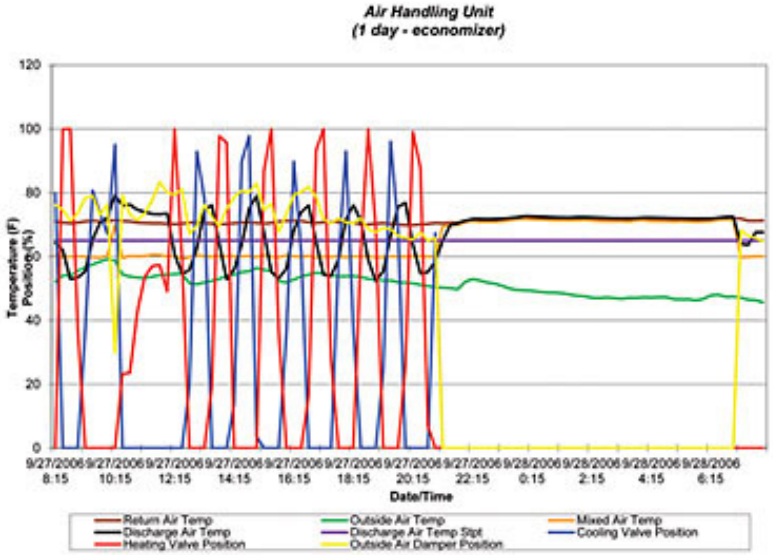
*Exceptions:*

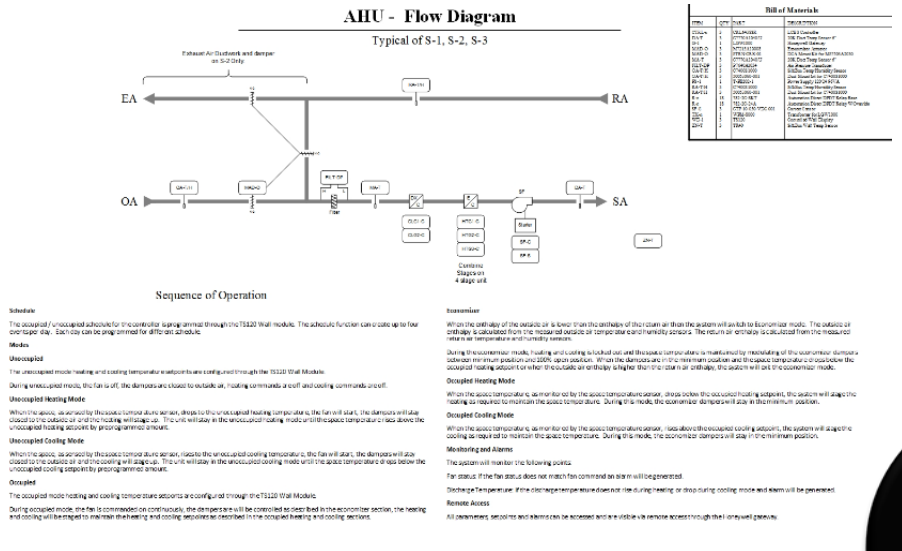
- *Mechanical systems less than 40 tons cooling*
- *Combined water/ space heating under 50 tons*

What?

# AHU Example




What?

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# Cx Value & Timing

Increased Value ⟷ Lower Initial Cost


| Pre-Design | Design | Construction | (Acceptance) | Occupancy |
|---|---|---|---|---|

When?

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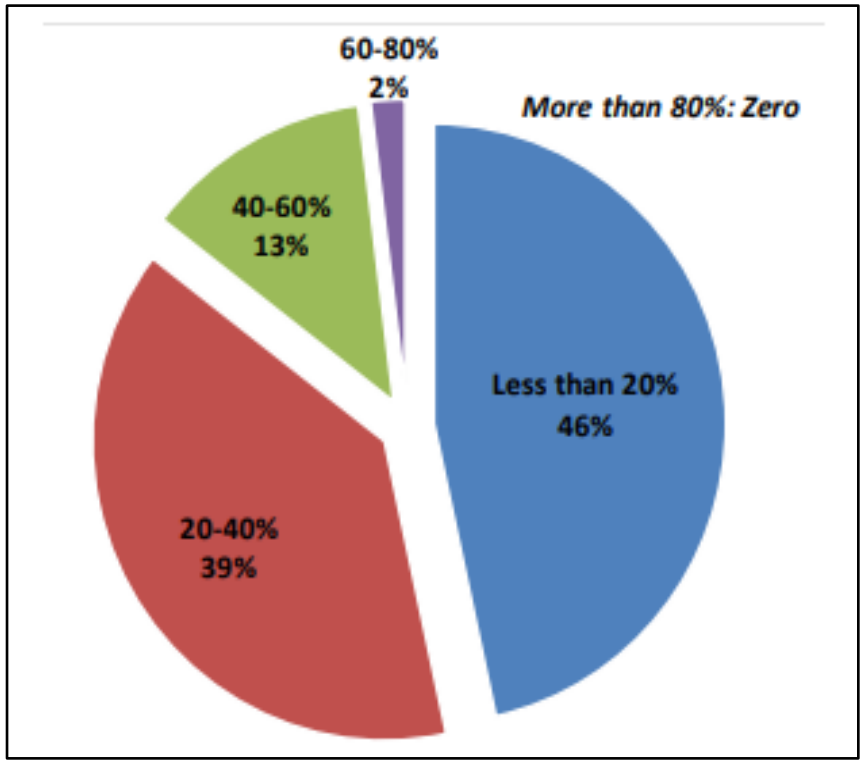
# Cx Value & Timing




*Per BCxA 2018 Market Survey

*"It's easier to fix things on paper, with a pencil, than in the field, with a power tool."*

- 25% of issues are found during Design Phase
- Design phase issues are quickly resolved
- Design phase issues are cheaper to resolve

When?

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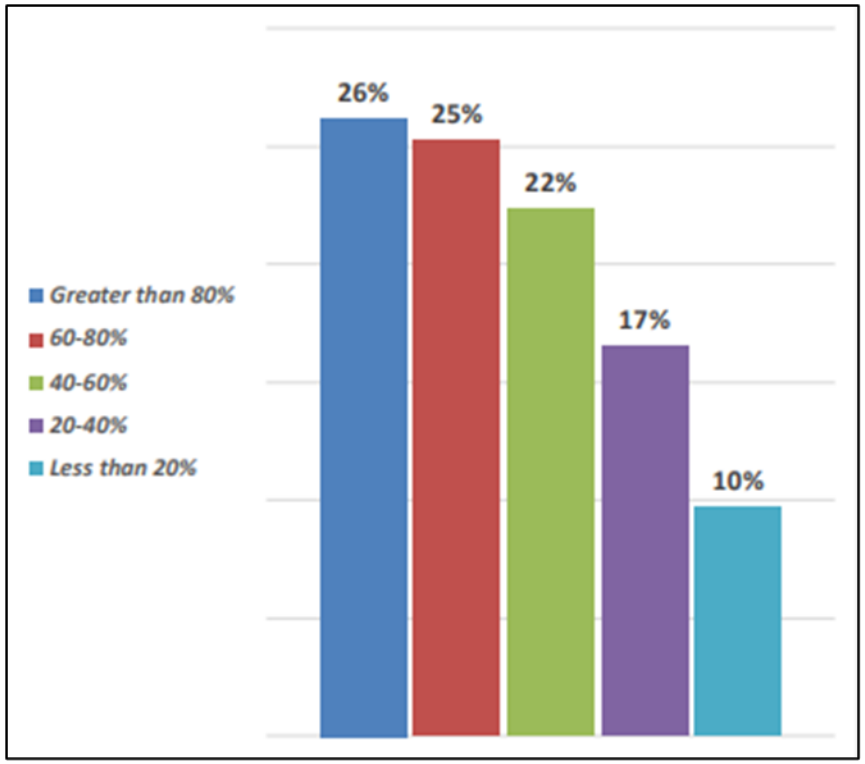
# Cx Best Practice




*Per BCxA 2018 Market Survey

## Trends in Commissioning Application

- 26% of clients start Cx at Design Phase 80%+
- 25% of clients start Cx at Design Phase 60%+
- Added fee is nominal vs vale added

When?

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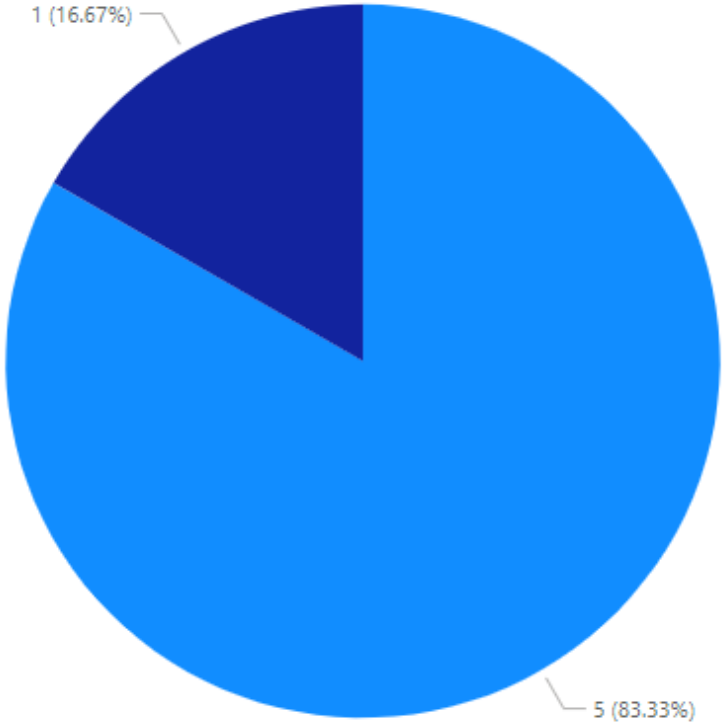
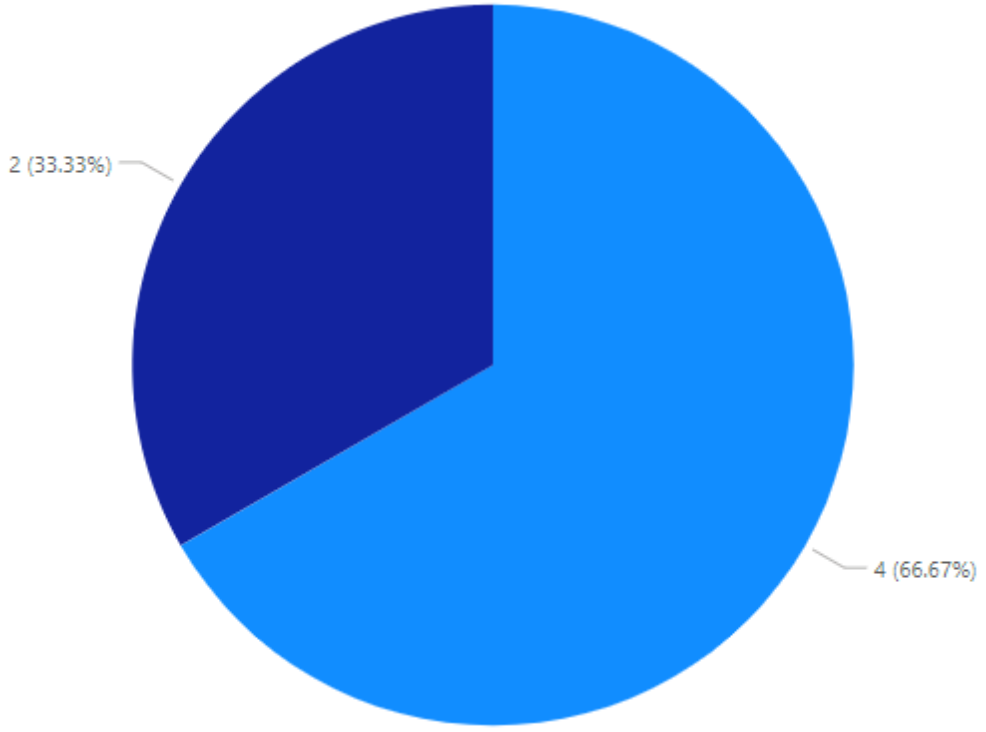
# Our Findings

## K-12 Start Phase Trends




From 6 most recent K-12 projects

## Higher Ed Start Phase Trends




From 6 most recent Higher ed projects

When?

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# Recent Examples

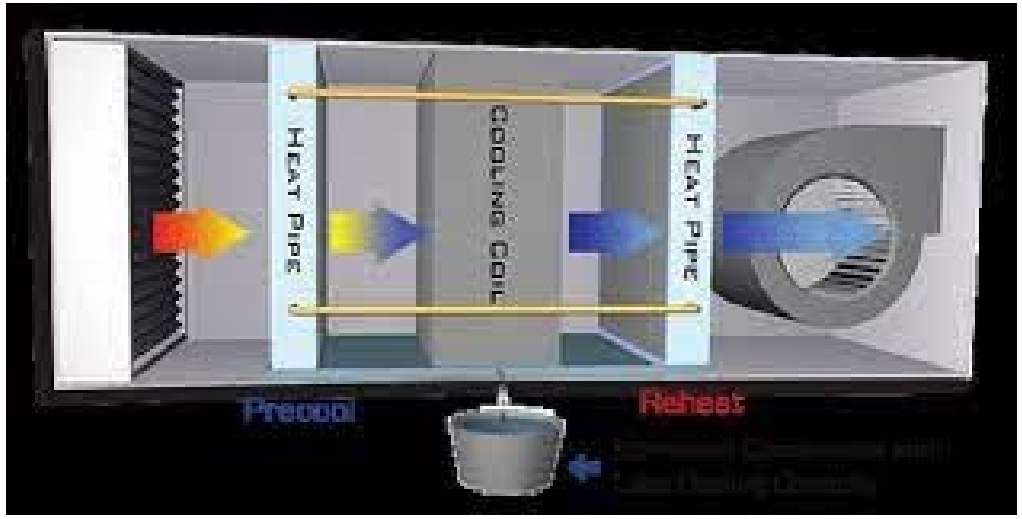
## K-12 Client Cost Avoidance

- Nearly replaced CHW distribution due to age
- Conducted a study with Ultrasonic Testing
- Freed up thousands for reallocation

Brooksville Elementary School – CHW Study

## Higher Ed Cost Avoidance

- Discovered mis-sized heat pipe design
- Corrected issue and changed order
- Prevented delays, earned LEED points




UF Historical Hall Heat Pipe sizing

Why?

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## New Construction Commissioning (NCCx)

- Code Compliant Cx
- Fundamental Commissioning
- Enhanced Commissioning

# COMMISSIONING (Cx)

Monitoring-based Commissioning

Ongoing Commissioning

Re-commissioning

Continuous Commissioning

Retro-commissioning

## Halfway there!

What?

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# Post-Occupancy Cx Processes

<u>Ongoing (Continuous) Commissioning (OCx):</u>

- Sustain and optimize building performance
- Meet the current facility requirements (CFR)
- 2-year cycle of *continuous* commissioning
- Part of LEED enhanced systems commissioning

<u>Monitoring-Based Commissioning (MBCx):</u>

- Utilizes automated data analytics
- Continuously monitors system performance
- Can be part of an OCx Plan
- Also part of LEED enhanced systems commissioning



What?

# Post-Oc/ Existing Building (EBCx) Cx Processes

Re-Commissioning (Re-Cx):

- Ideal for tuning up a previously Cx'd building
- Restore design intent
- Restore operational efficiency
- Offset "drift" and "Override Joe"


Retro-Commissioning (RCx):

- Ideal for older facilities
- Initial/ after-the-fact Cx effort
- Can inform capital invest
- Good for establishing performance baseline

What?

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# OCx & MBCx Examples

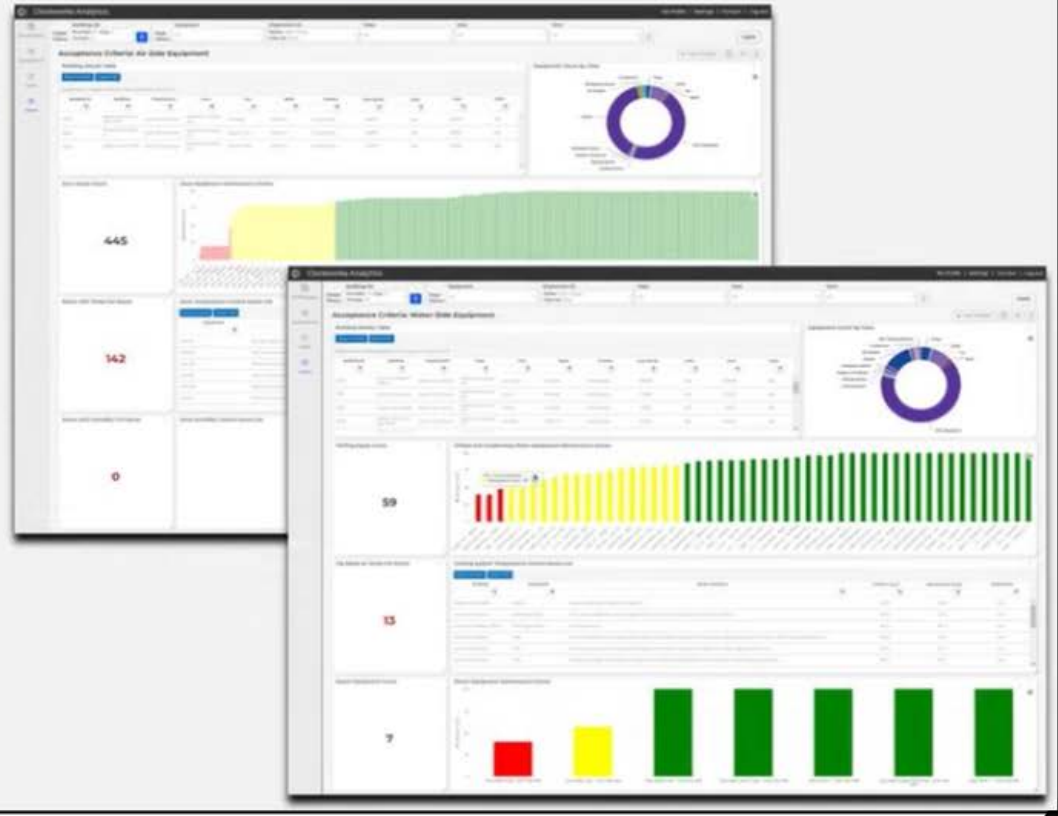
## Cx Acceptance Criteria | Summary

**Scope:** Cx plans are not considered complete until an approved set of Acceptance Criteria is in place.

**Requirements:**

1. On the EOR's plans or specifications , or
2. On a stamped, signed, and dated memo from the EOR to the CxA, and
3. In the Commissioning Plan

**Goal:** Demonstrate the value of the selected design.



What?

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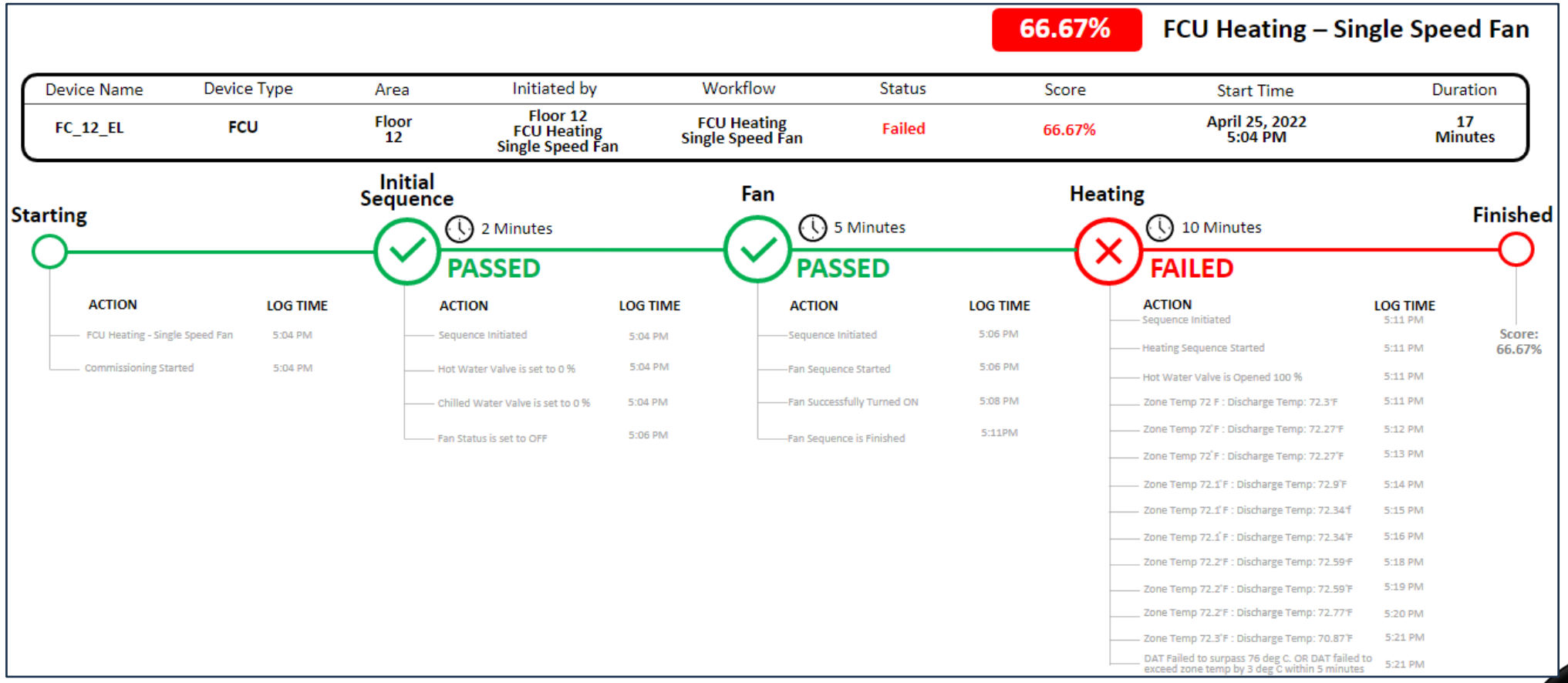
# OCx & MBCx Examples




What?

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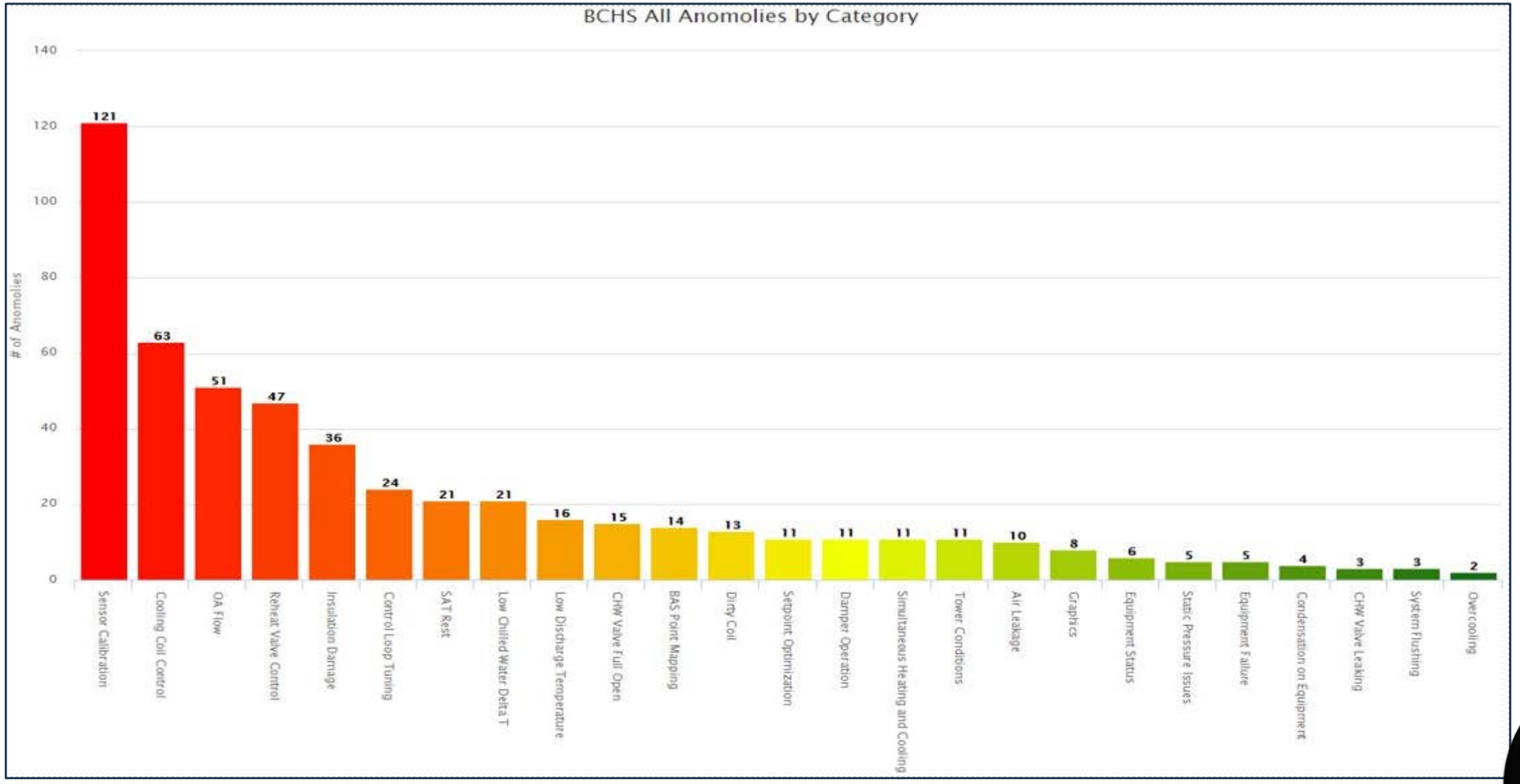
# OCx & MBCx Examples




What?

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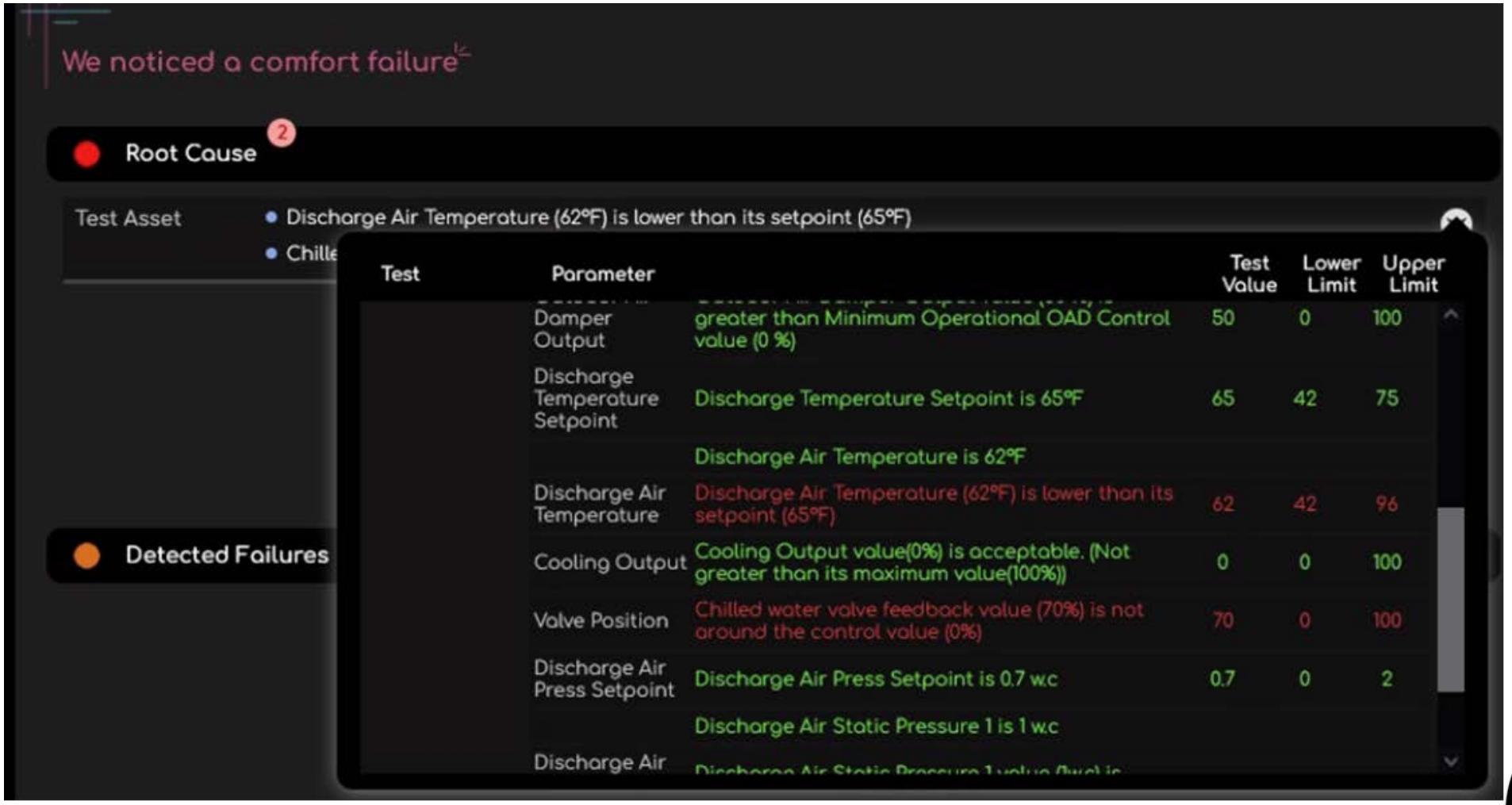
# OCx & MBCx Examples




**Digital Twin Platforms**

What?

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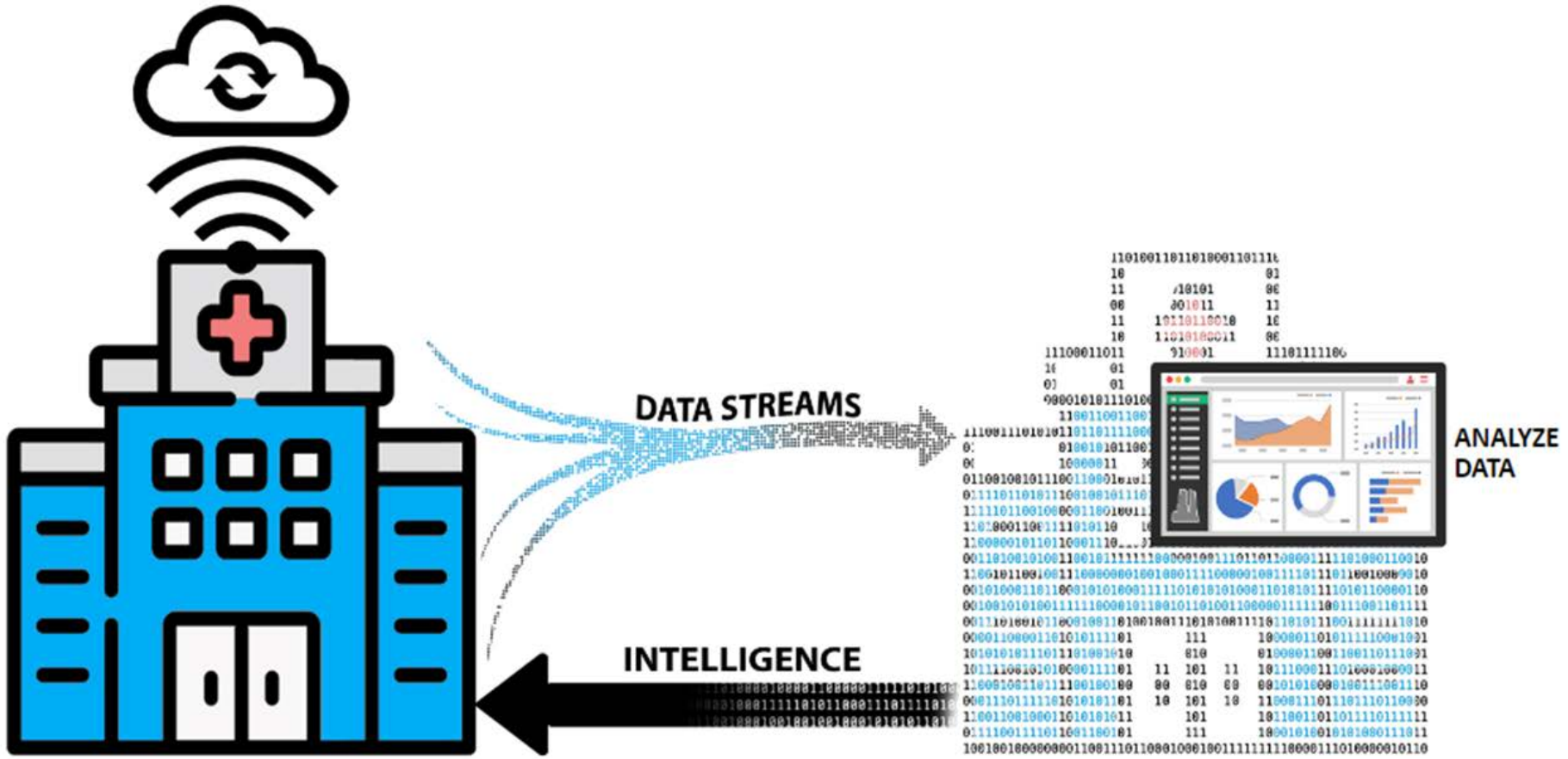
# OCx & MBCx Examples




What?

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# Re & Retro Cx Survey

Re-Commissioning (Re-Cx):

- How many occupy or operate a Cx'd building?
- Have any buildings that were Cx'd over 5 years ago?
- Has operational efficiency dropped?
- Do you employ an "Override Joe"?

Retro-Commissioning (RCx):

- How many occupy or operate older buildings?
- Have they ever been Cx'd?
- Could you use some guidance regarding capital invest?
- Have you ever established performance baseline?

What?

# Relevant Data

<u>According to the 2021 America's Infrastructure Report:</u>

- There are 67 School Districts in Florida
- Nearly 3,600 K-12 Schools
- 180,000 permanent classrooms
- Average Building Age is **31** years old

<u>According to Florida Deferred Maintenance Report:</u>

- FL colleges and universities have a DM backlog
- Various repair and replacement projects are needed
- PECO funding won't meet the need
- Average Building Age is **24** years old

Why?

# Re & Retro Example


Santa Fe College:

- Mixture of Cx'd and non-Cx'd buildings
- Prioritized older Retro-Cx first
- Re-Cx of newer buildings after
- Focused on one building at a time
- Various use-changes over the years
- Excellent record keeping for reference
- Sought direction and energy savings
- Multiple findings per building

Why?

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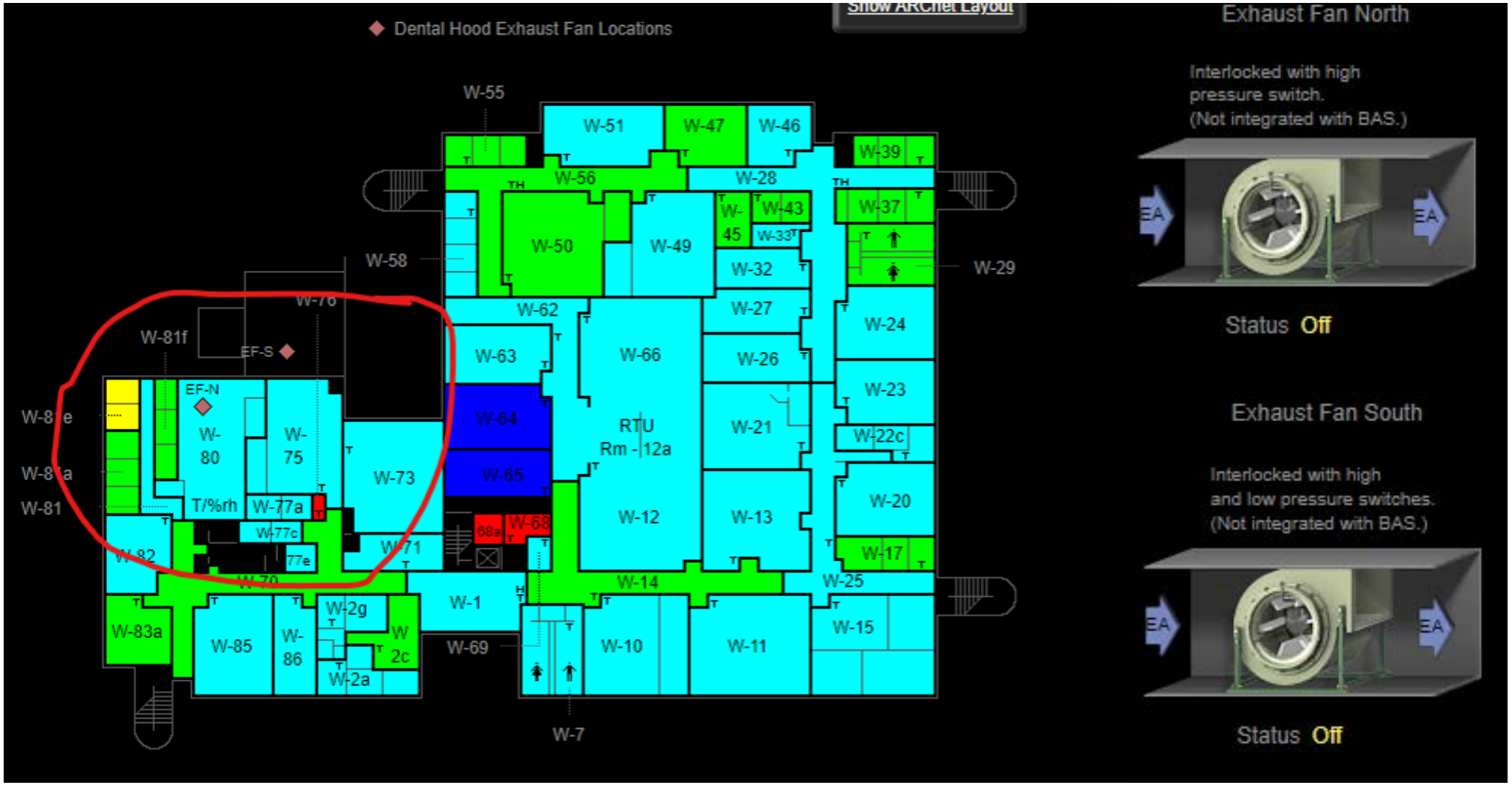
# Re & Retro Example




Why?

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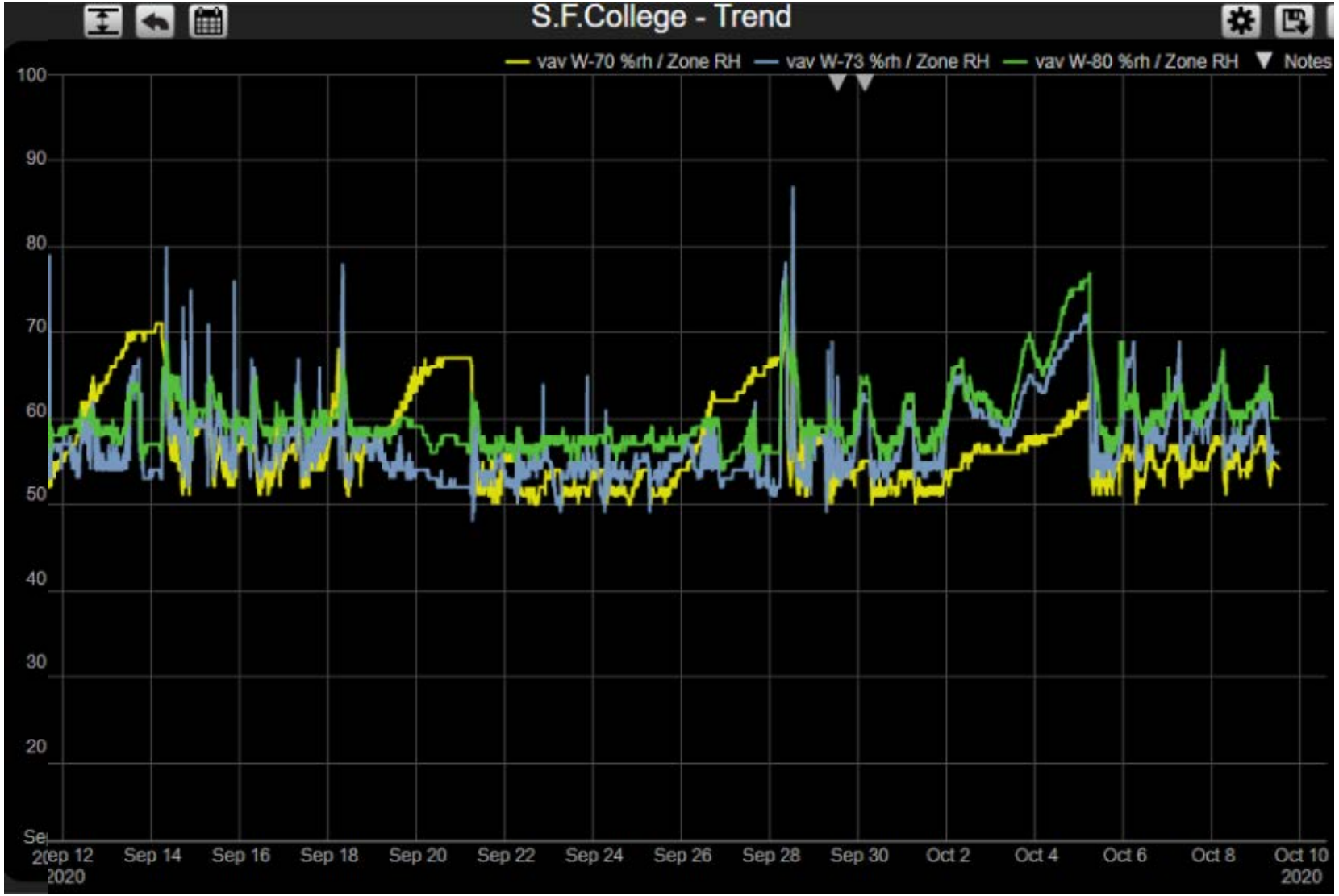
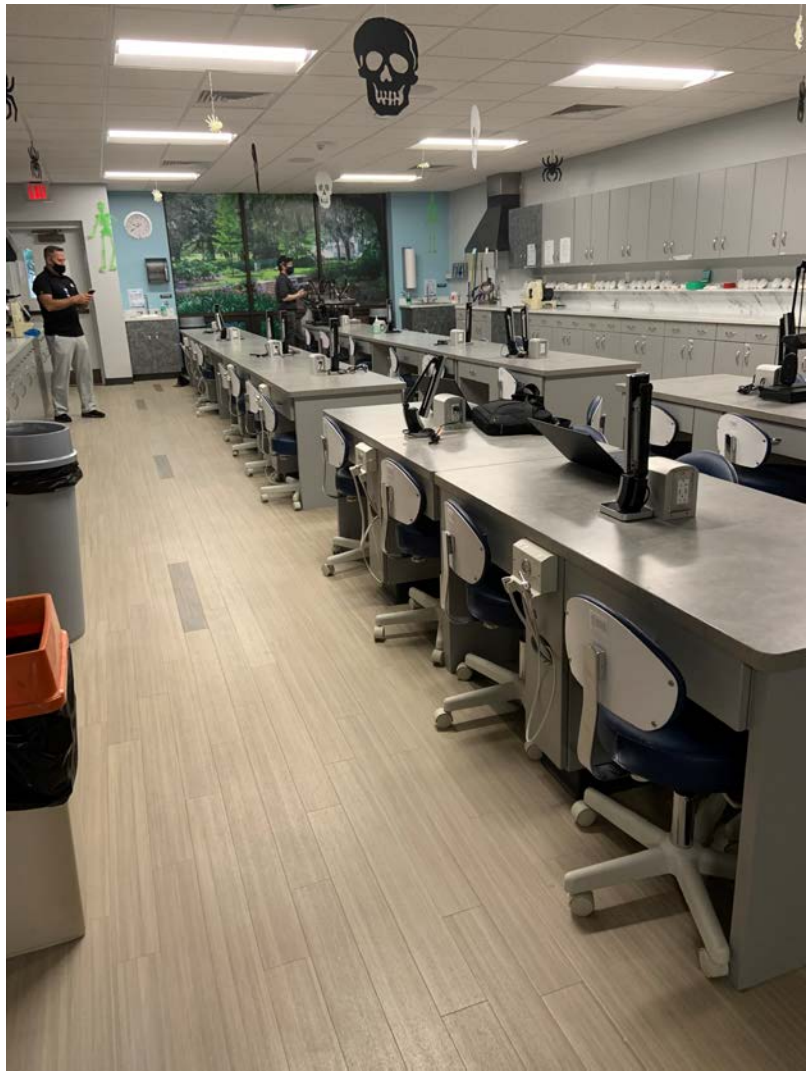
# Re & Retro Example




Why?

# Re & Retro Example




Why?

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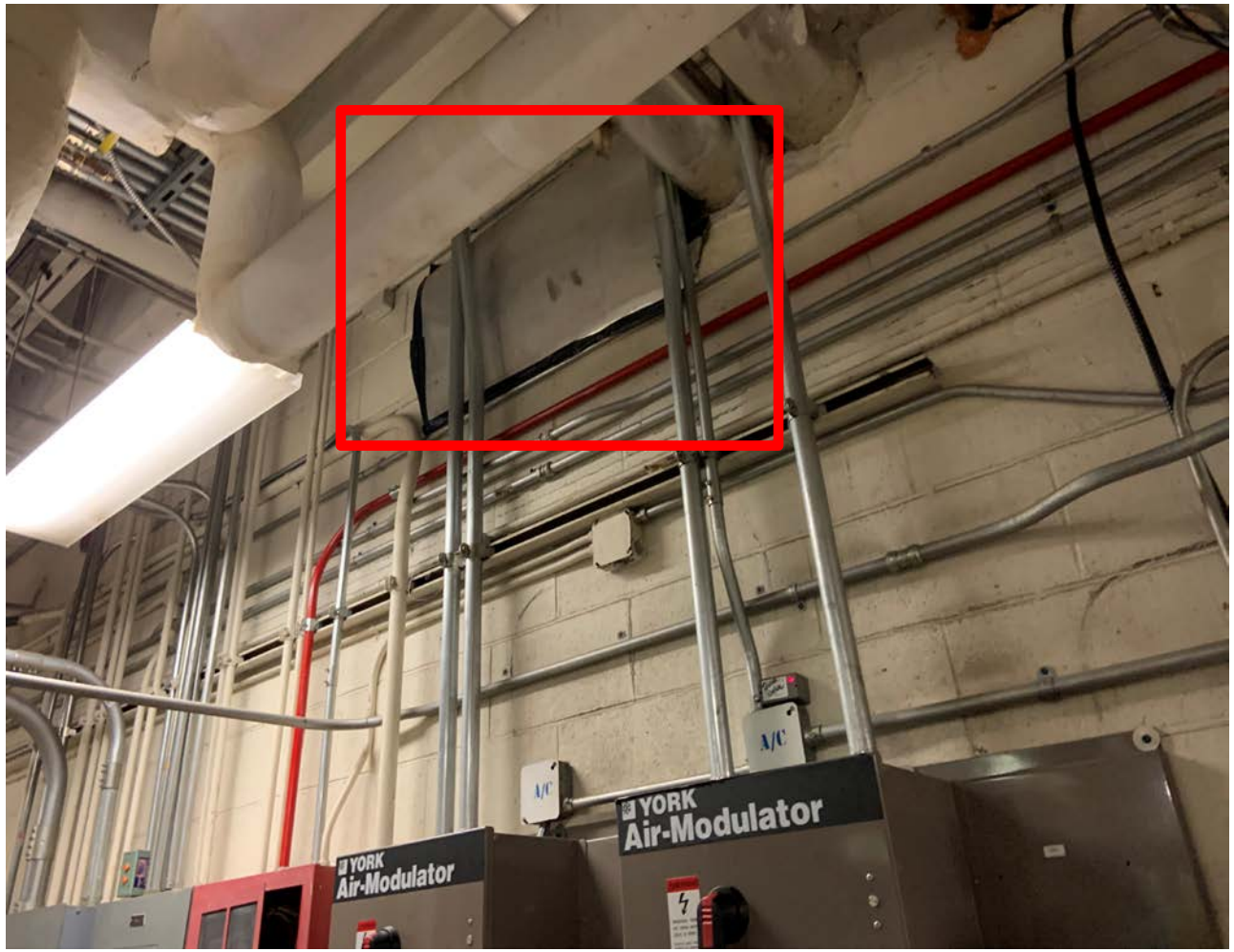
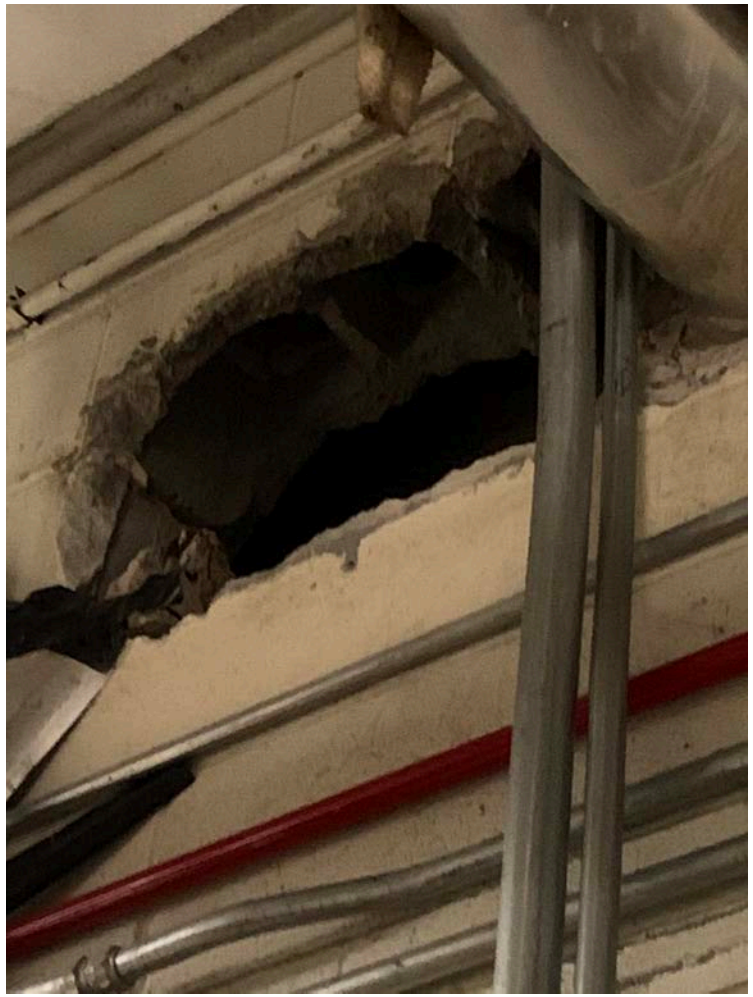
# Re & Retro Example



Why?

# Re & Retro Example



Why?

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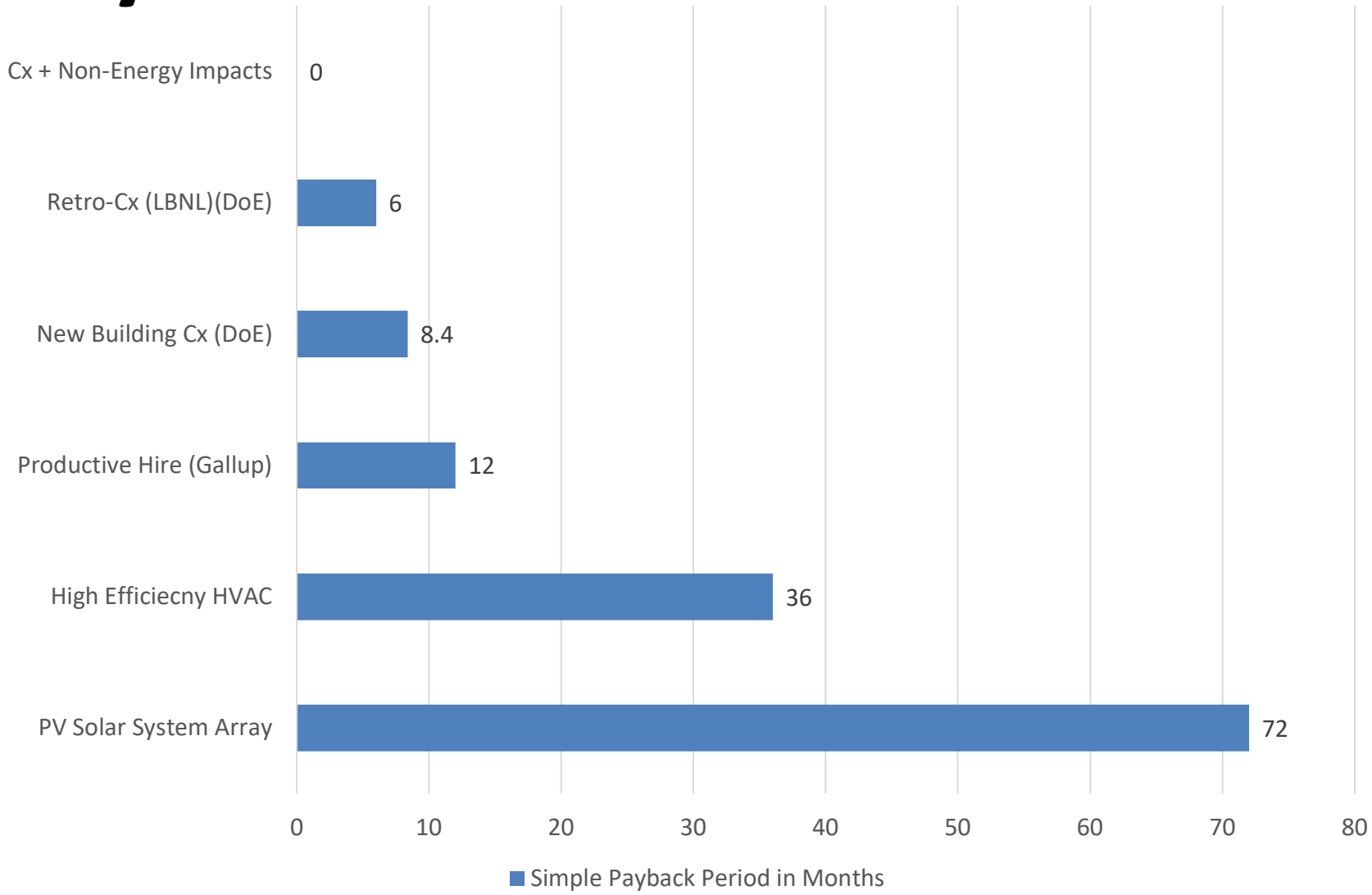
# Simple Payback




Why?

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## New Construction Commissioning (NCCx)

- Code Compliant Cx
- Fundamental Commissioning
- Enhanced Commissioning

# COMMISSIONING (Cx)

## Post Oc/ Existing Building Cx (EBCx)

- Ongoing/ Continuous Commissioning
- Monitoring-based Commissioning
- Re & Retro-commissioning

## Better?

What?

# Facility Condition Assessment (FCA)

What?

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# FCA Defined

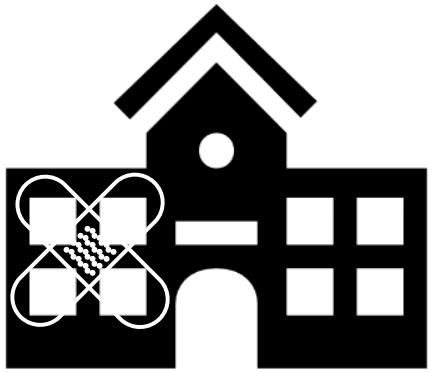
A comprehensive evaluation of a building's physical condition.

The purpose of an FCA is to:

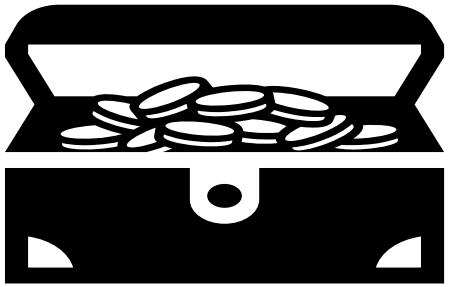
- Identify any existing or potential problems
- Determine if the building is suitable for its intended functions
- Prioritize repairs
- Help determine preventive maintenance, repairs, and upgrades
- Provide recommendations for addressing issues
- Provide financial forecasting, if requested

What?

# FCA Timing



When facility is in decline



When repair funds are available


When an extra set of eyes is needed

Following unexpected damages

When?

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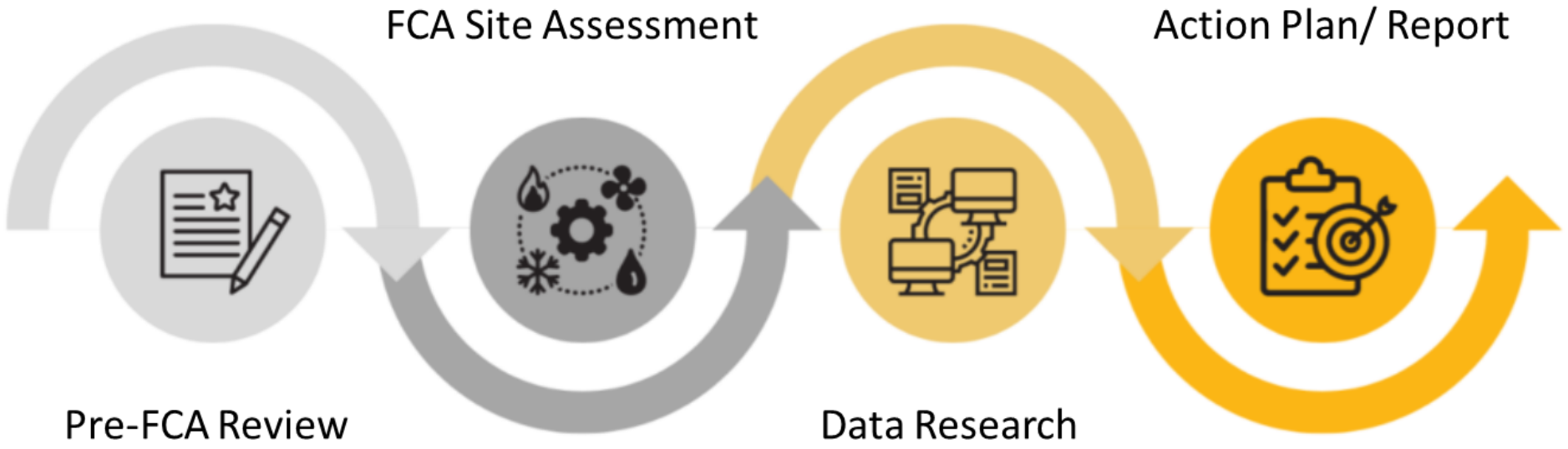
# FCA Process




What?

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# FCA Best Practices

# FCA + TAB

- Great for informing design
- Next best baseline to Retro-Cx
- Quick turn-around time
- Can be easily compiled

Why?

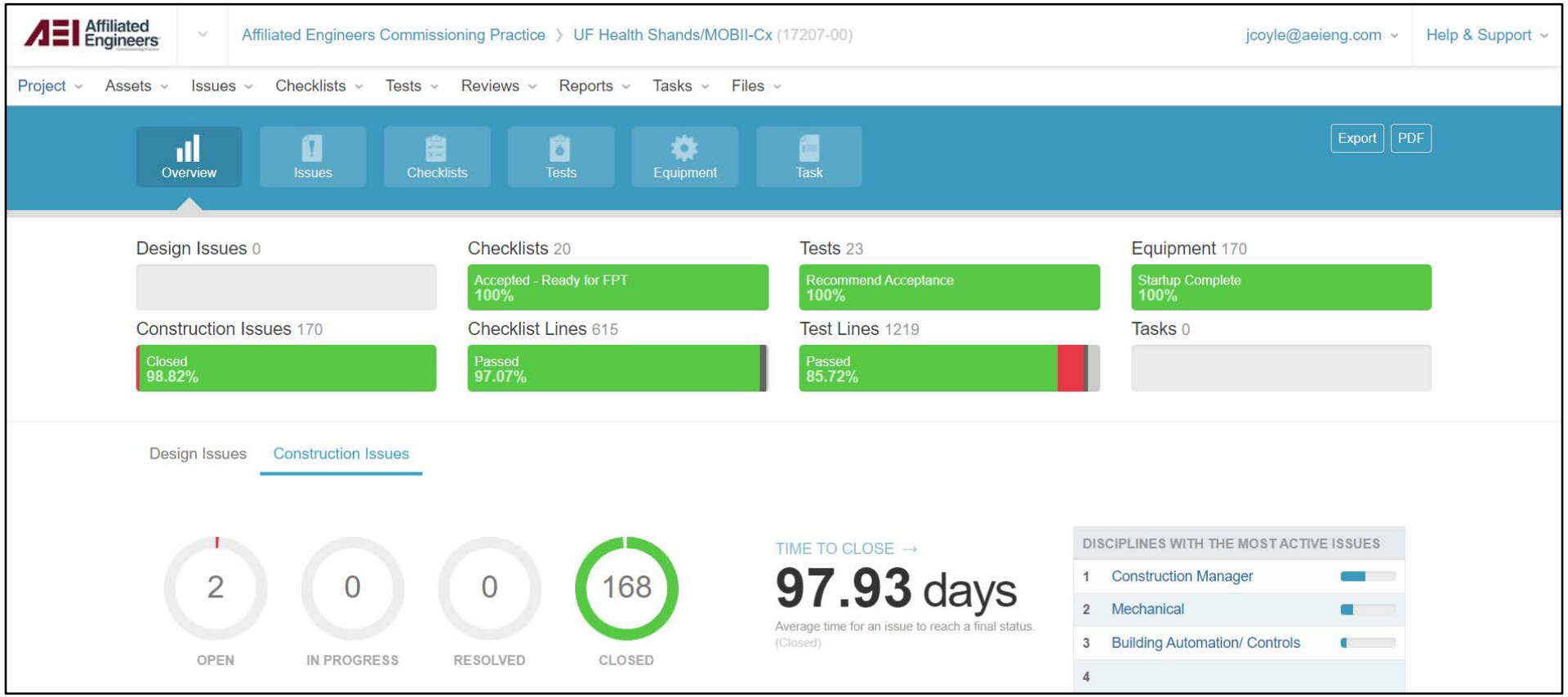
# FCA and Cx Process Delivery

Not all FCA and Cx processes are created equal, so look for the following:

- Intuitive, live software, with full export capability
- A teamwork and resource-oriented philosophy that creates buy-in
- An efficient, integrated approach that limits duplication of effort
- Ability to provide meaningful, valuable data following effort

Why?

# Intuitive Live Software




What?

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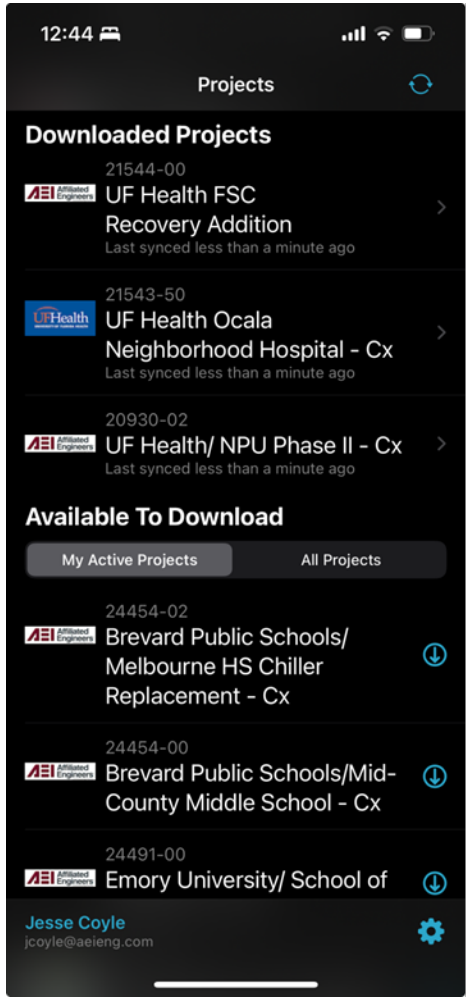
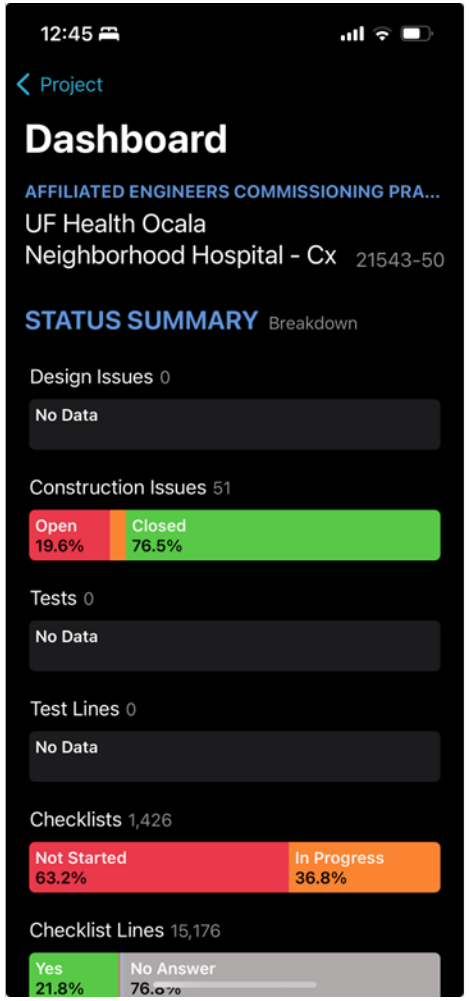
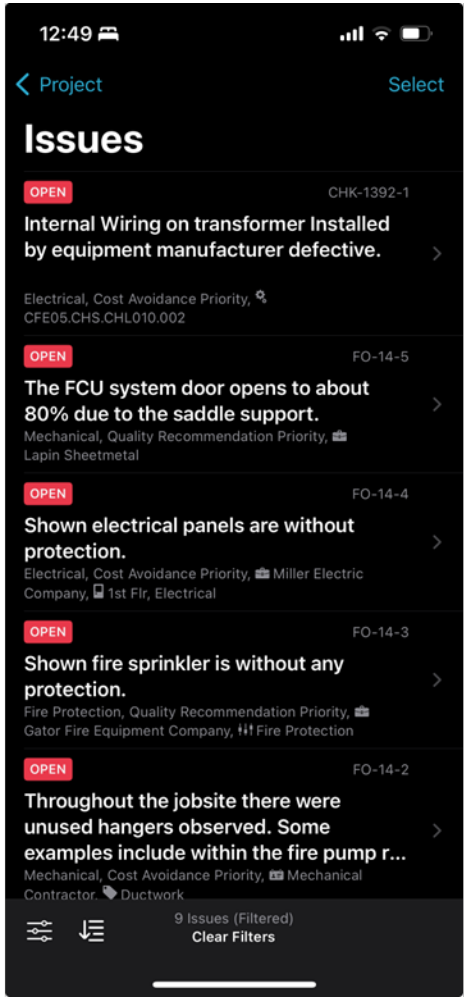
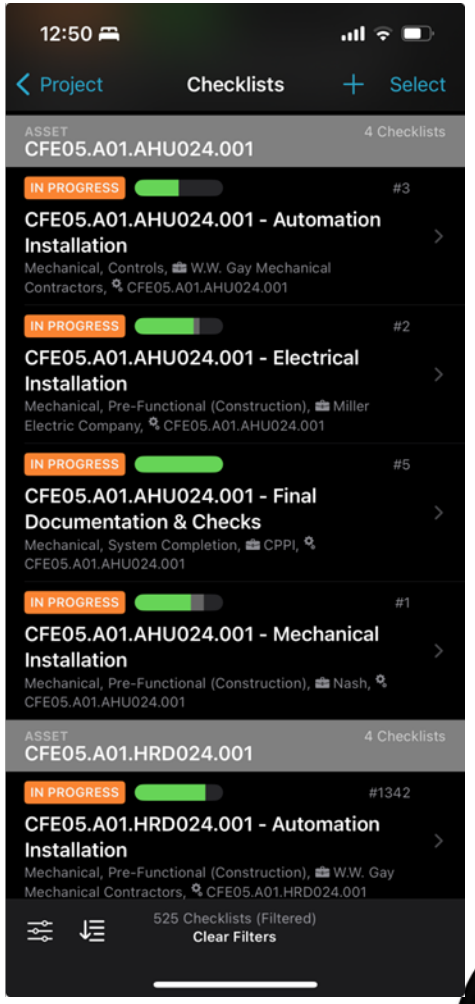
# Intuitive Live Software




What?

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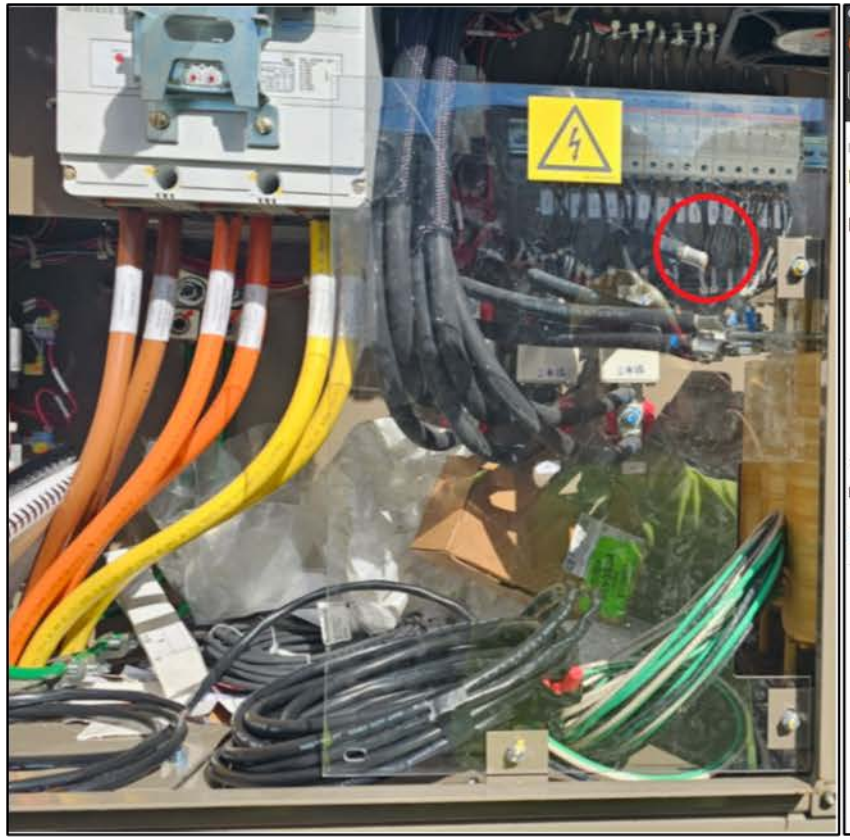
# Resource Oriented Approach



CONSTRUCTION ISSUE

CHK-1392-1 OPEN COST AVOIDANCE

Mark as In Progress | Assign To | Delete | Edit

Return to List | « Previous | CHK-1392-1 | Next » | Watch | Email | PDF

DESCRIPTION

Internal Wiring on transformer Installed by equipment manufacturer defective.

Broken Termination

ASSIGNED TO Nolan Davis
*General Contractor, CPPI*

ASSET CFE05.CHS.CHL010.002
Air Cooled Chiller
CHW
Yard

PRIORITY Cost Avoidance
DISCIPLINE Electrical
DRAWING
DUE DATE 1/31/2024

SOURCE Checklist 1392, Line 1
Electrical connections are complete

CREATED BY Steven Videon
IDENTIFIED ON 1/24/2024 at 11:08:19 AM

COMMENTS 1

Have something to add, Jesse?

Add Comment

Steven Videon
*Electrical Contractor, Miller Electric Company*
Jan 24, 2024 at 11:08 am

Have equipment manufacturer re-terminate broken transformer tap. #1

Edit Delete

What?

Affiliated Engineers

# Resource Oriented Approach

+

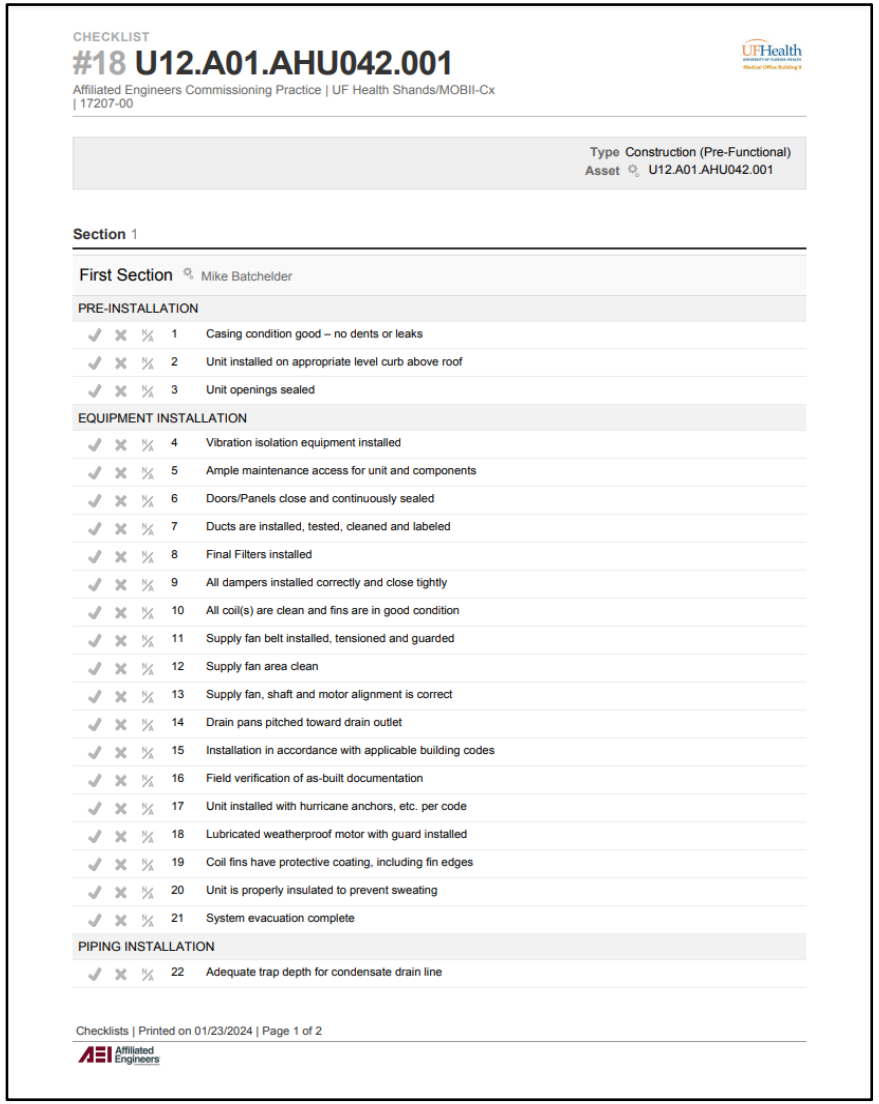
VS

+

What?

Affiliated Engineers

# Efficient, Integrated Approach



CHECKLIST

## #18 U12.A01.AHU042.001

Affiliated Engineers Commissioning Practice | UF Health Shands/MOBII-Cx | 17207-00

Type Construction (Pre-Functional)
Asset U12.A01.AHU042.001

**Section** 1

**First Section** Mike Batchelder

| | | |
|---|---|---|
| **PRE-INSTALLATION** | | |
| ✓ ✗ ½ | 1 | Casing condition good – no dents or leaks |
| ✓ ✗ ½ | 2 | Unit installed on appropriate level curb above roof |
| ✓ ✗ ½ | 3 | Unit openings sealed |
| **EQUIPMENT INSTALLATION** | | |
| ✓ ✗ ½ | 4 | Vibration isolation equipment installed |
| ✓ ✗ ½ | 5 | Ample maintenance access for unit and components |
| ✓ ✗ ½ | 6 | Doors/Panels close and continuously sealed |
| ✓ ✗ ½ | 7 | Ducts are installed, tested, cleaned and labeled |
| ✓ ✗ ½ | 8 | Final Filters installed |
| ✓ ✗ ½ | 9 | All dampers installed correctly and close tightly |
| ✓ ✗ ½ | 10 | All coil(s) are clean and fins are in good condition |
| ✓ ✗ ½ | 11 | Supply fan belt installed, tensioned and guarded |
| ✓ ✗ ½ | 12 | Supply fan area clean |
| ✓ ✗ ½ | 13 | Supply fan, shaft and motor alignment is correct |
| ✓ ✗ ½ | 14 | Drain pans pitched toward drain outlet |
| ✓ ✗ ½ | 15 | Installation in accordance with applicable building codes |
| ✓ ✗ ½ | 16 | Field verification of as-built documentation |
| ✓ ✗ ½ | 17 | Unit installed with hurricane anchors, etc. per code |
| ✓ ✗ ½ | 18 | Lubricated weatherproof motor with guard installed |
| ✓ ✗ ½ | 19 | Coil fins have protective coating, including fin edges |
| ✓ ✗ ½ | 20 | Unit is properly insulated to prevent sweating |
| ✓ ✗ ½ | 21 | System evacuation complete |
| **PIPING INSTALLATION** | | |
| ✓ ✗ ½ | 22 | Adequate trap depth for condensate drain line |

Checklists | Printed on 01/23/2024 | Page 1 of 2

#18 U12.A01.AHU042.001 | Affiliated Engineers Commissioning Practice | UF Health Shands/MOBII-Cx | 17207-00

| | | |
|---|---|---|
| ✓ ✗ ½ | 23 | Condensate pipe complete and properly mounted |
| **ELECTRICAL INSTALLATION** | | |
| ✓ ✗ ½ | 24 | Disconect enclosure is appropriate for space |
| ✓ ✗ ½ | 25 | No excessive temperatures, moisture or dirt at VFD |
| ✓ ✗ ½ | 26 | Power disconnects in place and labeled |
| ✓ ✗ ½ | 27 | All electric connections tight |
| ✓ ✗ ½ | 28 | Proper grounding for components and unit |
| ✓ ✗ ½ | 29 | Unit has power and is interlocked with control system |
| ✓ ✗ ½ | 30 | Overload breakers installed and correct size |
| ✓ ✗ ½ | 31 | All lights installed and operational |
| **AUTOMATION INSTALLATION** | | |
| ✓ ✗ ½ | 32 | OA flow station installed with proper inlet and outlet |
| ✓ ✗ ½ | 33 | Control hardware complete per documents |
| ✓ ✗ ½ | 34 | Control system interlocks hooked up and functional |
| ✓ ✗ ½ | 35 | Safety devices work in HAND or AUTO |
| ✓ ✗ ½ | 36 | Instruments tagged appropriately |
| ✓ ✗ ½ | 37 | Trending of all points enabled |
| **STARTUP AND OPERATION** | | |
| ✓ ✗ ½ | 38 | No unusual noise or vibration while running |
| ✓ ✗ ½ | 39 | Refrigerant charge meets manufacturer requirements |
| ✓ ✗ ½ | 40 | Manufacturer installation checklist completed |
| **DUCTWORK INSTALLATION** | | |
| ✓ ✗ ½ | 41 | Duct insulation and vapor barrier properly installed |
| ✓ ✗ ½ | 42 | Diffusers, grilles, ductwork complete |
| ✓ ✗ ½ | 43 | Ducts cleaned per specifications |
| ✓ ✗ ½ | 44 | All duct joints properly sealed with approved mastic |
| ✓ ✗ ½ | 45 | Access doors installed, gaskets tight |
| **FINAL DOCUMENTATION AND CHECKS** | | |
| ✓ ✗ ½ | 46 | Units labeled correctly per specifications |
| ✓ ✗ ½ | 47 | Operation and maintenance information provided |
| ✓ ✗ ½ | 48 | Start-up report |
| ✓ ✗ ½ | 49 | Control drawings |
| ✓ ✗ ½ | 50 | Provide manufacturer's installation and operation data |

Checklists | Printed on 01/23/2024 | Page 2 of 2

- PFCs are custom
- Compliment manufacturer documents
- Concisely written
- Merged meetings

Why?

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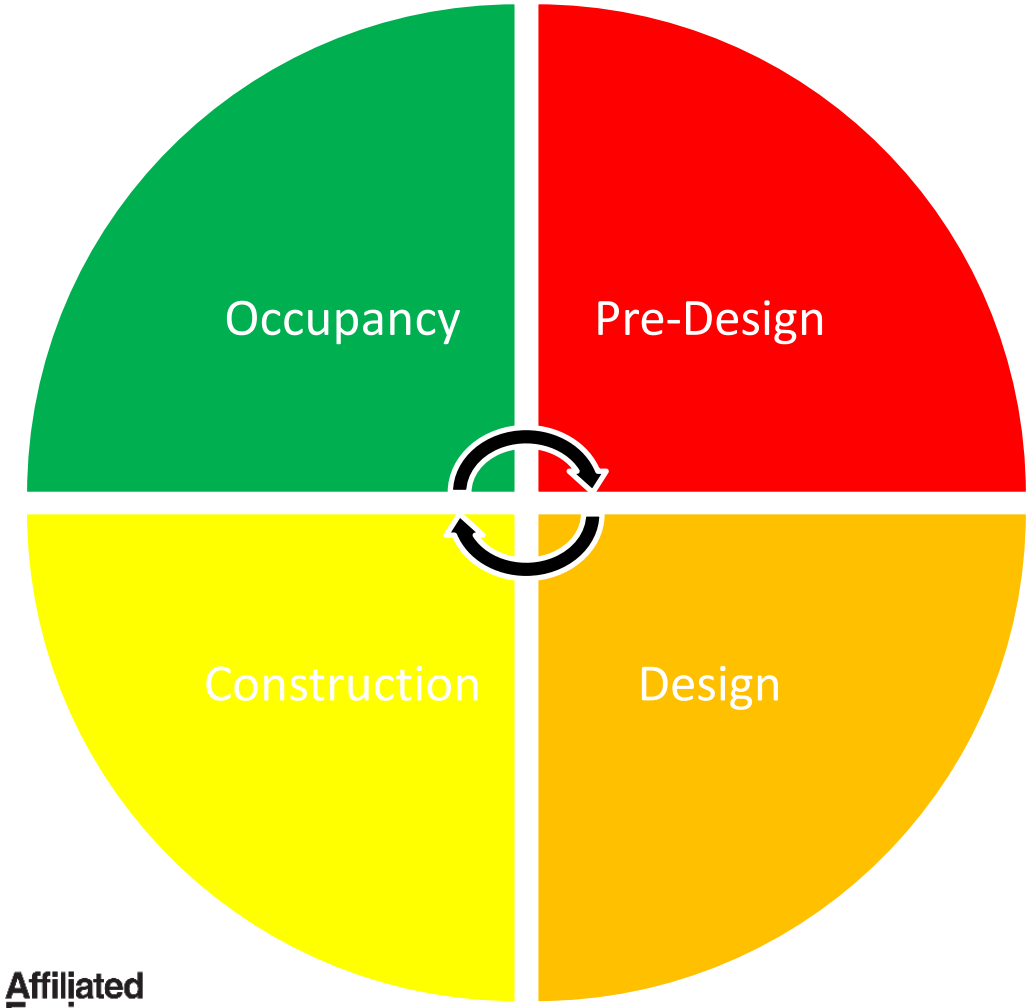
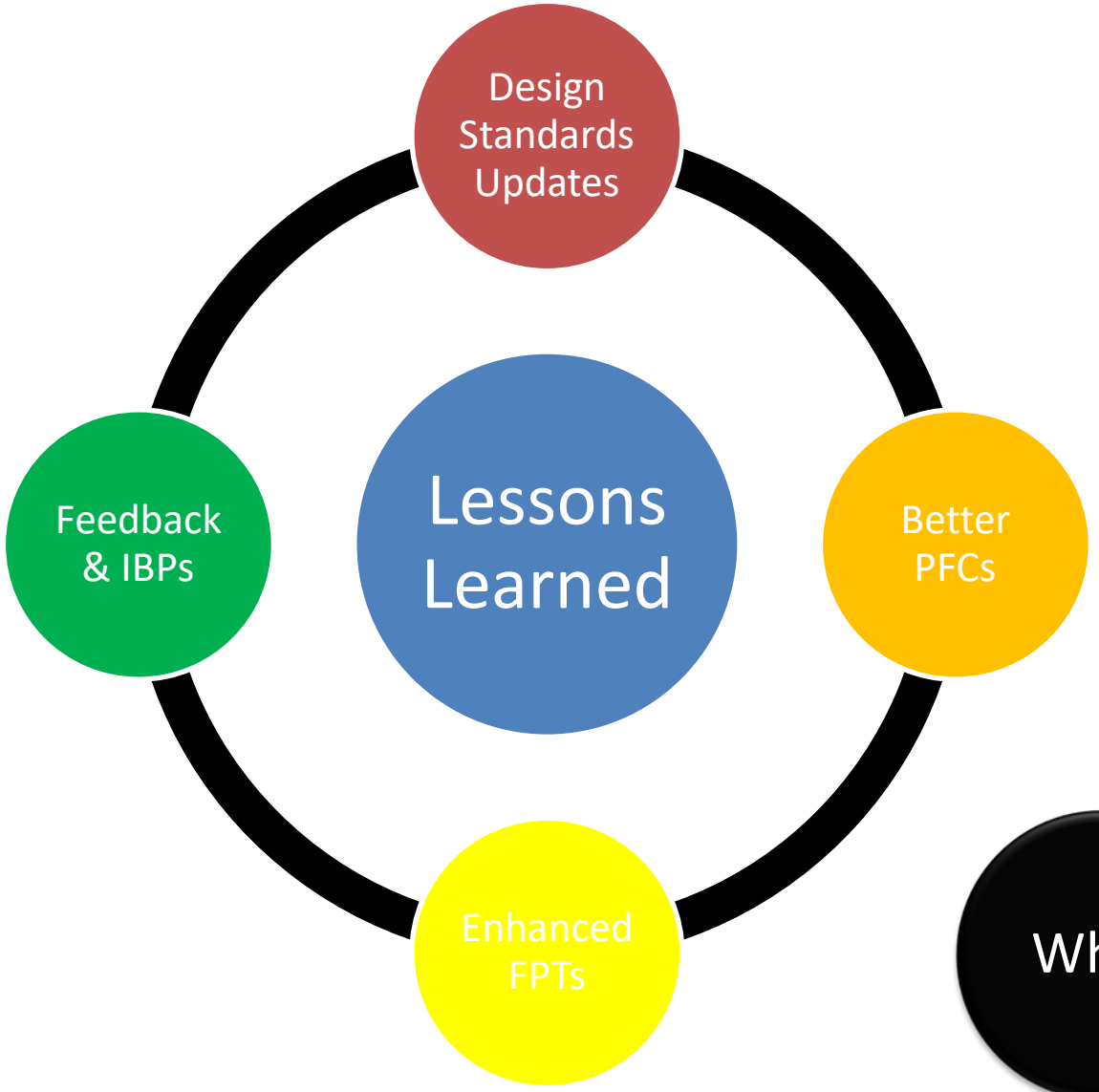
# Efficient, Integrated Approach

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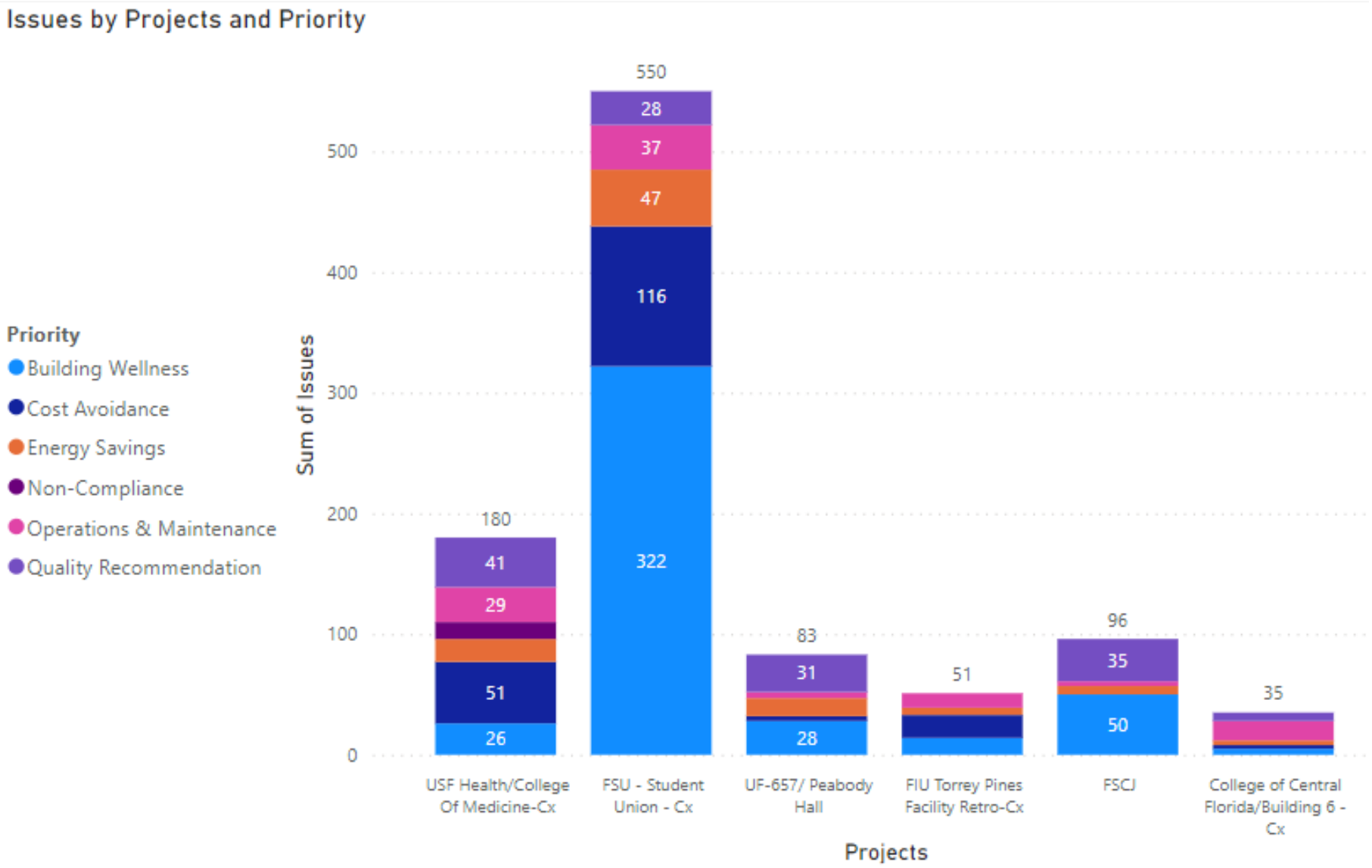
# Provide Meaningful Data

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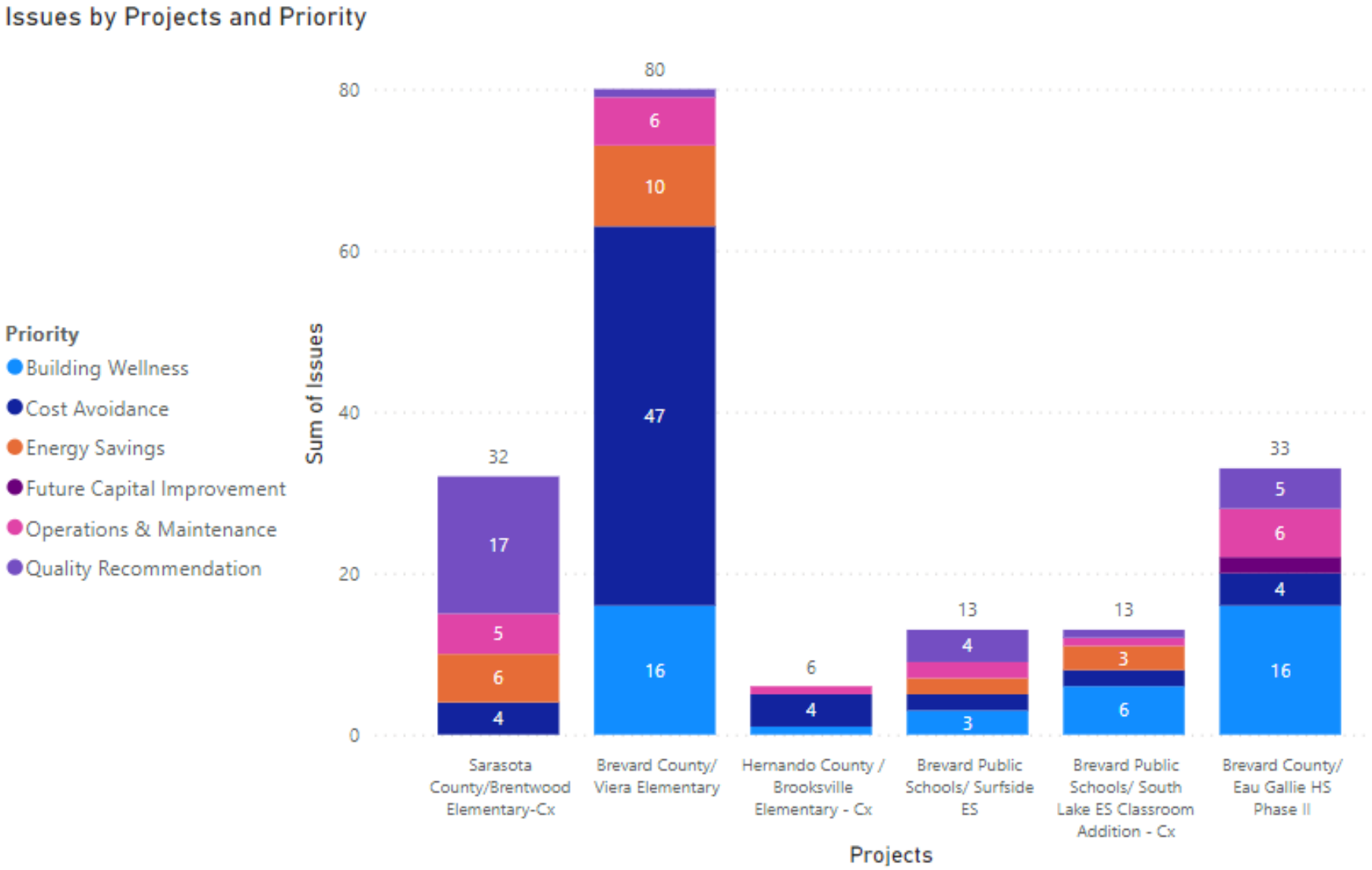


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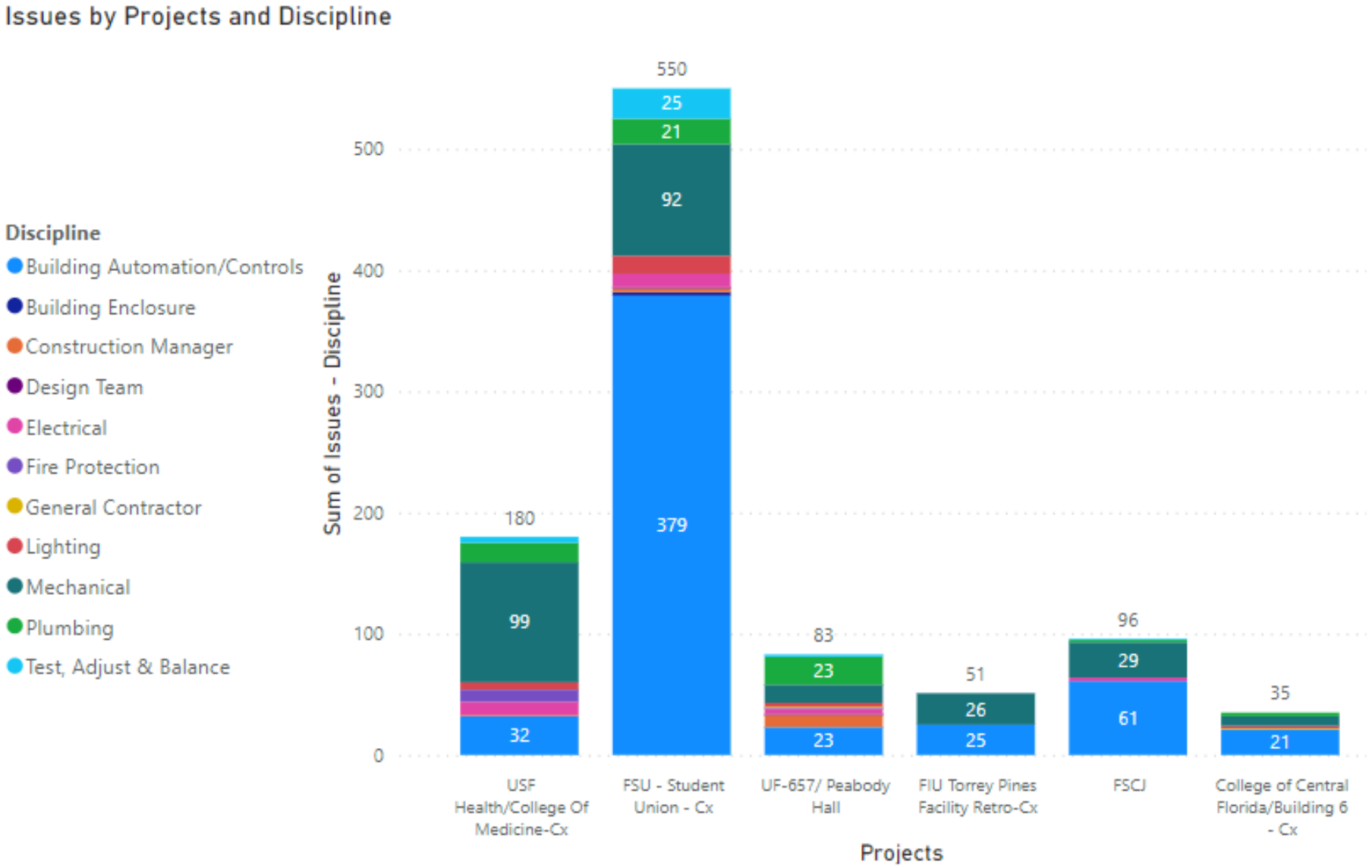


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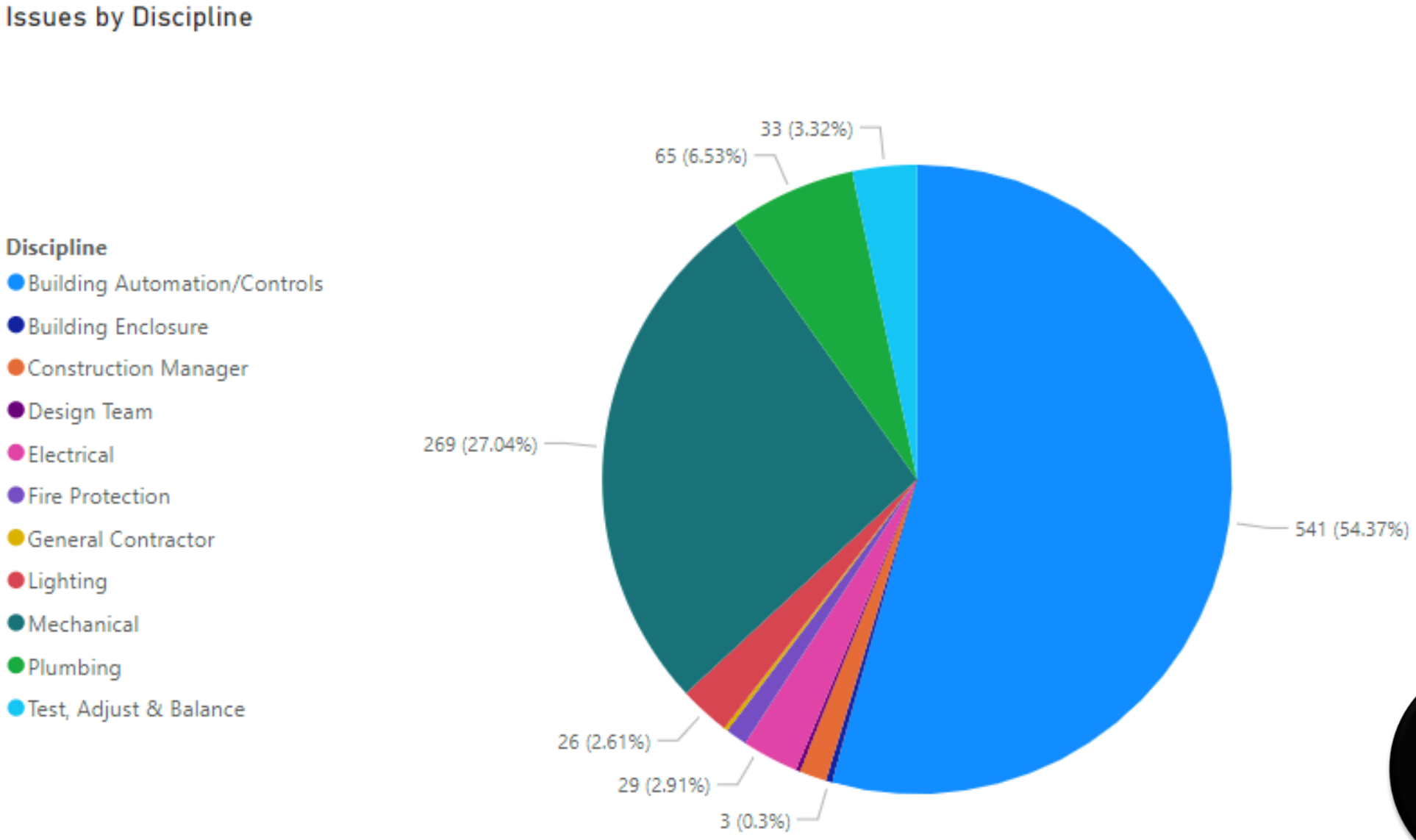


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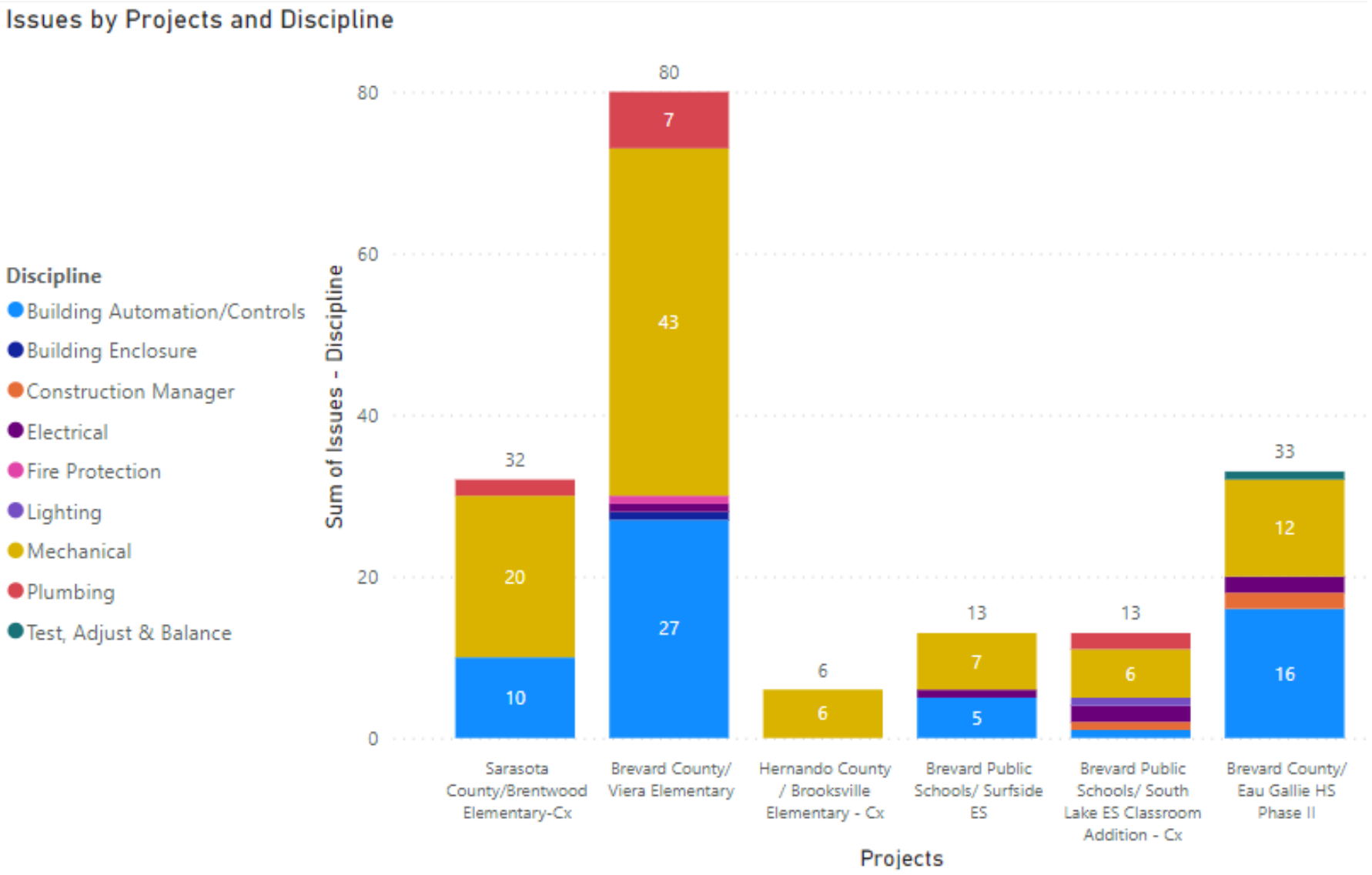


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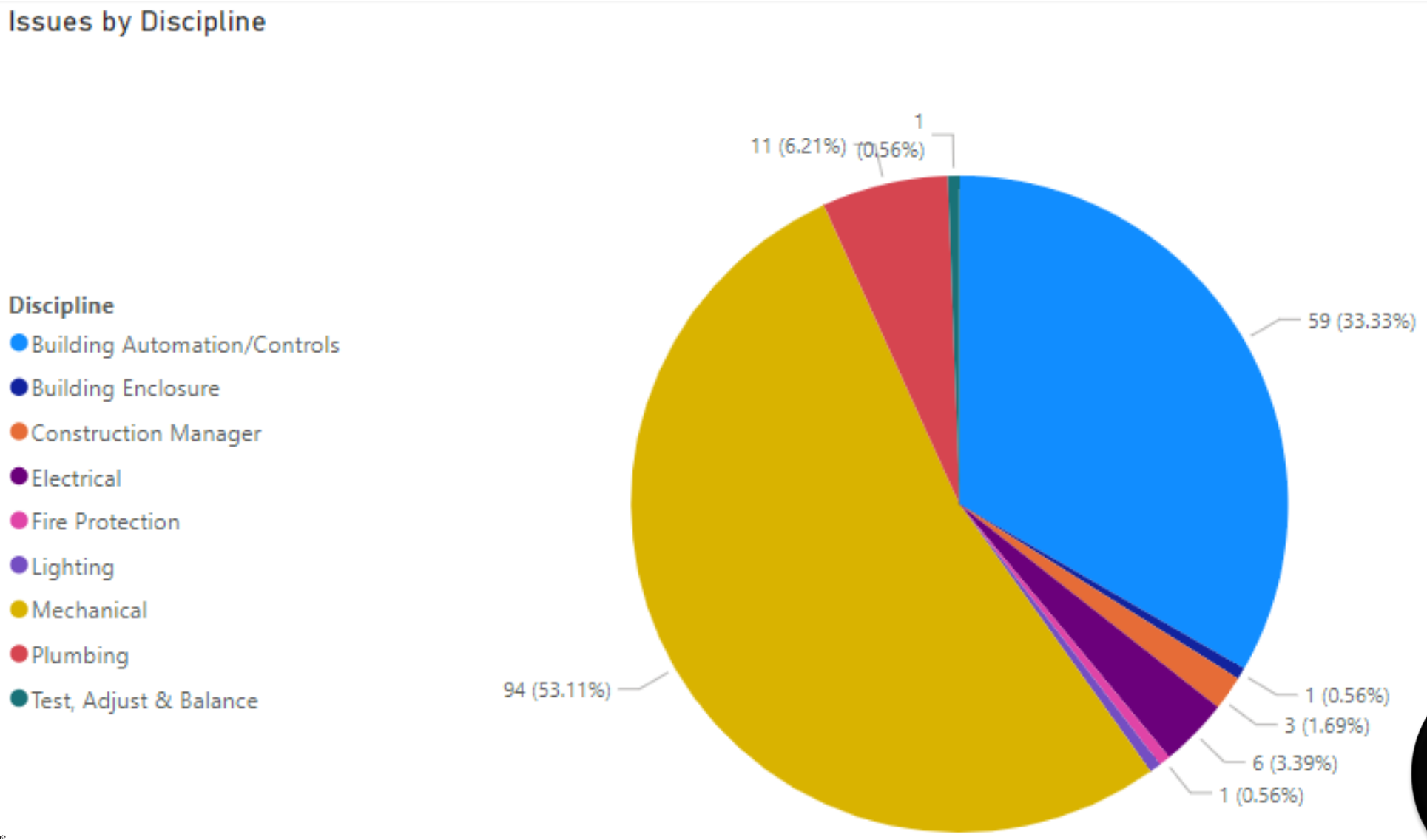


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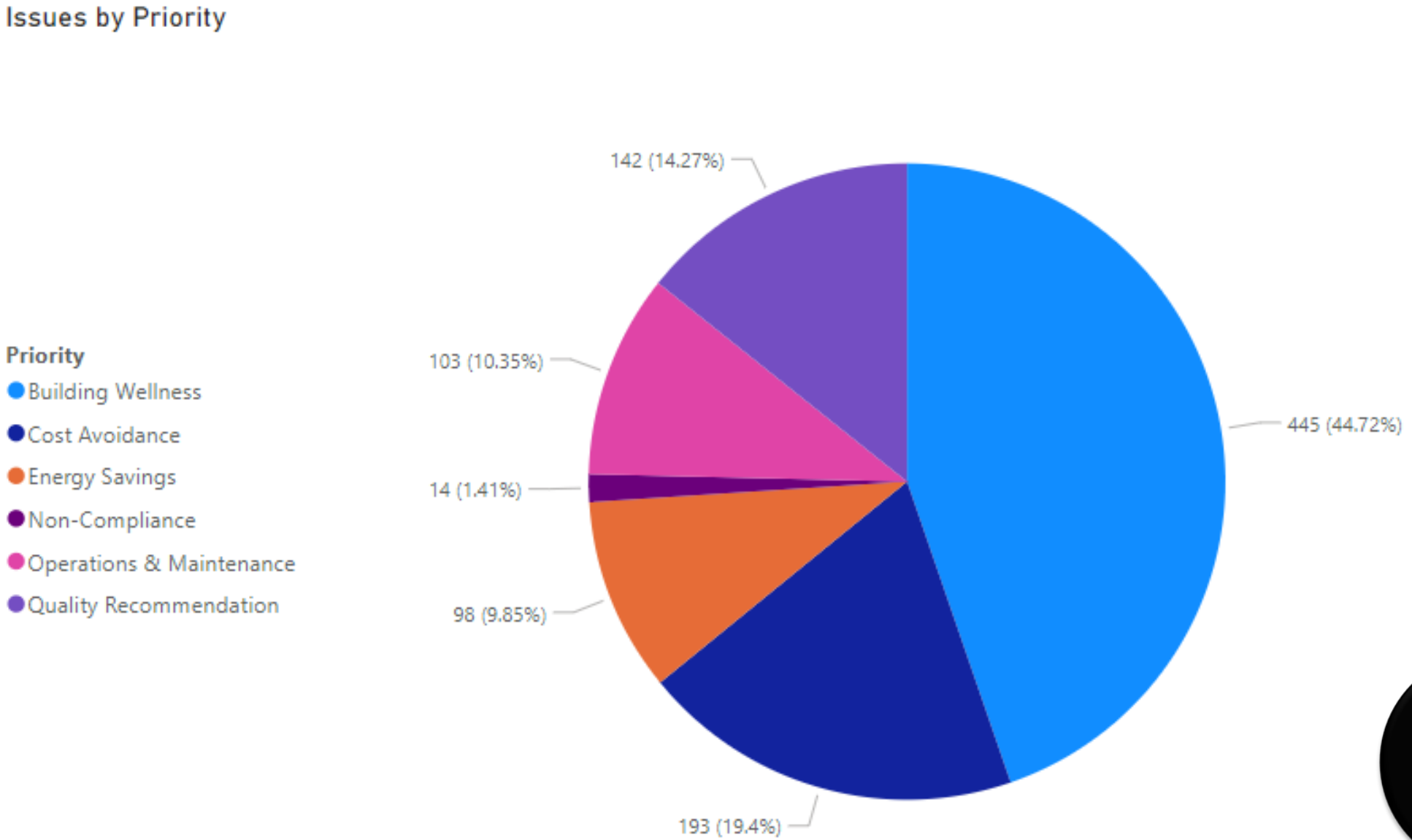


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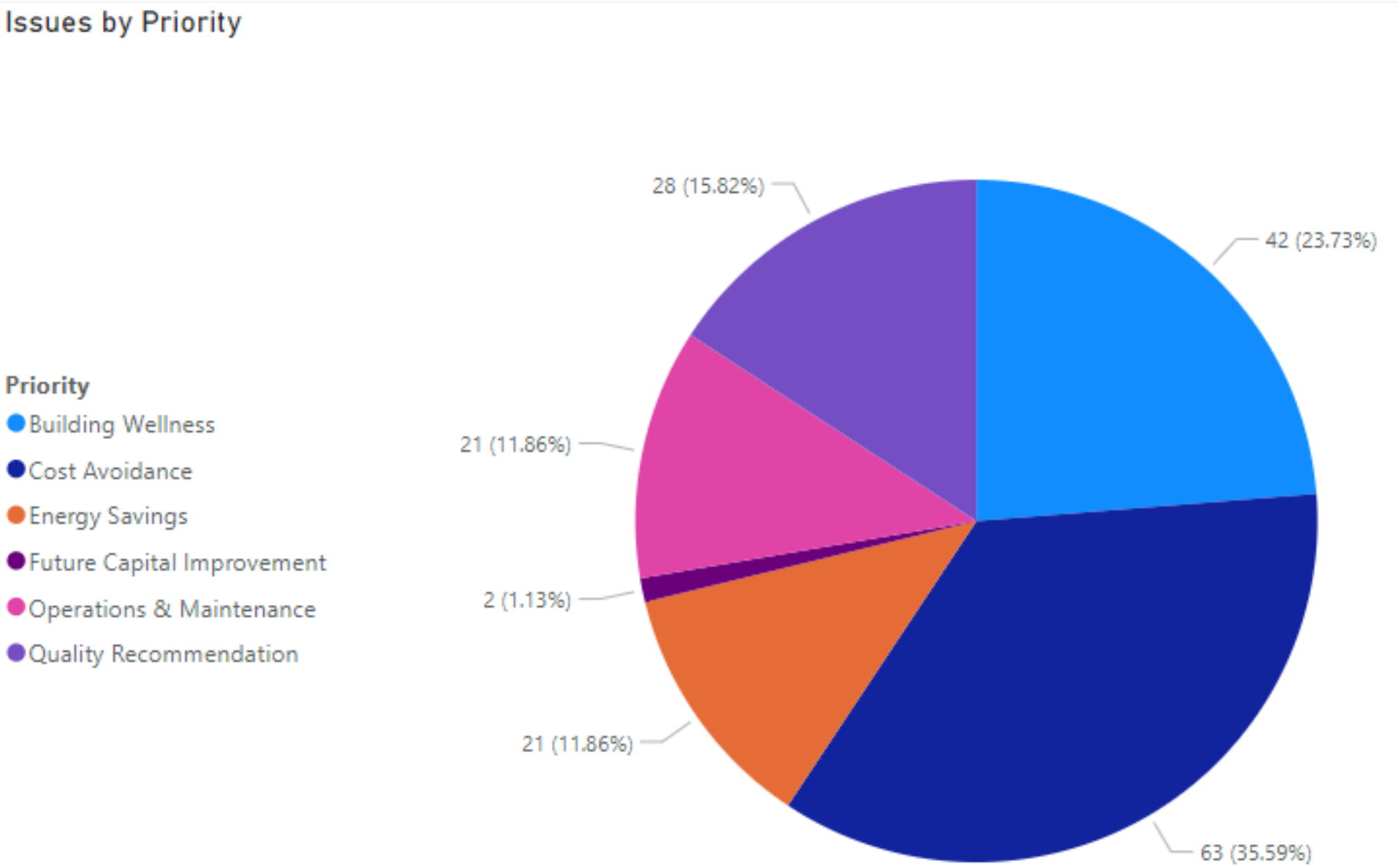


Why?

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# Provide Meaningful Data

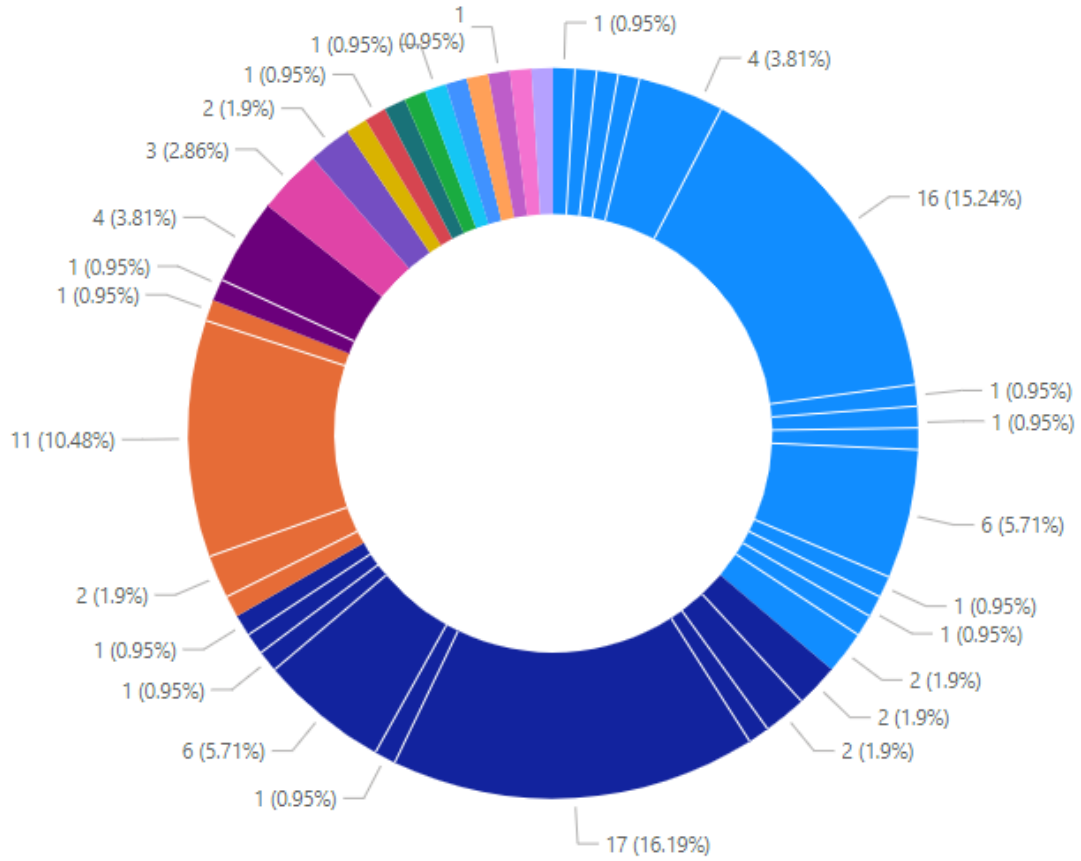
## Equipment by Space

107
Equipment

Electrical

Mechanical

Plumbing




**Space**
- Mechanical Room
- 1315 N. Florida Ave.
- 818 Griffin Road
- Electrical Room
- Boilers
- HW Heat Sys
- Decontam
- Gas Storage
- Housekeeping
- IT Server Room
- Jan Closet
- Locker Area
- Soiled Work
- Sterilizers
- Toilet
- Trash Room

1315 N. Florida Ave.

818 Griffin Road

| Equipment | Space |
|---|---|
| AC-1-Trane | 1315 N. Florida Ave. |
| AC-2-Trane | 1315 N. Florida Ave. |
| ACC-1 | 1315 N. Florida Ave. |
| AHU-1 | 1315 N. Florida Ave. |
| AHU-2 | 1315 N. Florida Ave. |
| CU-Mitsubishi | 1315 N. Florida Ave. |
| Disconnect LD | 1315 N. Florida Ave. |
| EF-1 | 1315 N. Florida Ave. |
| EF-10 | 1315 N. Florida |
| EF-11 | 1315 N. Florid |
| EF-12 | 1315 N. Florid |
| EF-13 | 1315 N. Florid |
| EF-14 | 1315 N. Florida |

Why?

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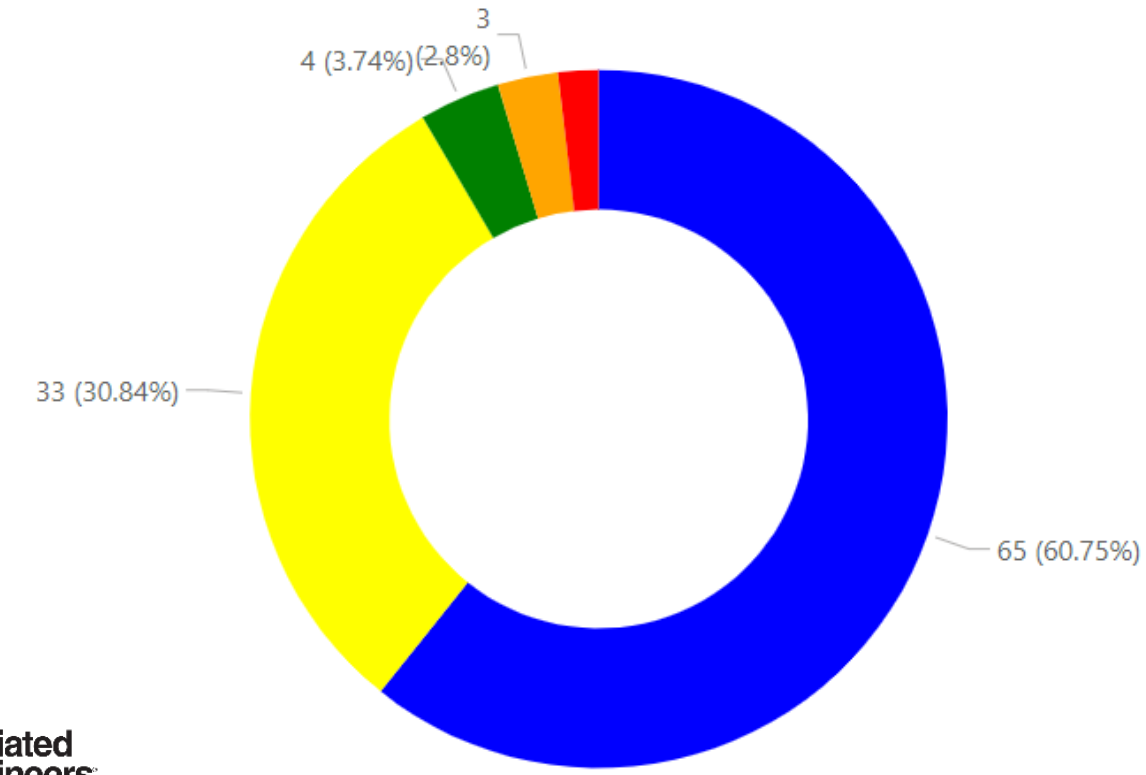
# Provide Meaningful Data

## Direct Condition Rating (DCR) Breakdown

Electrical | Mechanical | Plumbing

1315 N. Florida Ave. | 818 Griffin Road

**107**
Equipment




**DCR Status**
- 2
- 3
- 1
- 4
- 5

| Rating | Score |
|---|---|
| Great | 1 |
| Good | 2 |
| Fair | 3 |
| Repair | 4 |
| Replace | 5 |

Why?

Affiliated Engineers

# Provide Meaningful Data

## Equipment Assessment

1315 N. Florida Ave.

Electrical | Mechanical | Plumbing

818 Griffin Road

| Equipment | Age | DCR Status | Estimated Service Life | Remaining Service Life |
|---|---|---|---|---|
| AC-1-Trane | 8 | 2 | 15 | 7 |
| AC-2-Trane | 8 | 3 | 15 | 7 |
| ACC #1 Disconnect | 19 | 2 | 40 | 21 |
| ACC-1 | 19 | 3 | 15 | -4 |
| AC-MovinCool | 4 | 1 | 15 | 11 |
| AHU-1 | 35 | 6 | 35 | 0 |
| AHU-2 | 8 | 3 | 15 | 7 |
| Air Compressor | 19 | 2 | 20 | 1 |
| ATS | 19 | 2 | 40 | 21 |
| B-1 | 20 | 3 | 24 | 4 |
| B-2 | 20 | 3 | 24 | 4 |
| B-3 | 20 | 3 | 24 | 4 |
| CEH | 19 | 2 | 40 | 21 |
| Circulation Pump | 19 | 2 | 20 | 1 |
| CU-Mitsubishi | 8 | 2 | 15 | 7 |
| Disconnect LD | 19 | 2 | 40 | 21 |
| EDH | 19 | 2 | 20 | 1 |
| EF-1 | 38 | 4 | 50 | 12 |
| EF-10 | 18 | 2 | 25 | 7 |
| EF-11 | 19 | 2 | 25 | 6 |
| EF-12 | 19 | 2 | 25 | 6 |
| | 19 | 3 | 25 | 6 |
| | 9 | 2 | 25 | 16 |

**107**
Total pieces of equipment assessed

**2.38**
Average Direct Condition Rating of equipment assessed

**17.43**
Average Age of equipment assessed

**25.07**
Average Estimated Service Life of equipment assessed

**7.64**
Average Remaining Service Life of equipment assessed

Why?

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What?