Using Monitoring-Based Commissioning to Deliver Successful Controls Upgrade Projects for Existing Buildings

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Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.
Learning Objectives

1. Identify the tools required for successful monitoring based commissioning

2. Differentiate between existing BAS capabilities and MBCx

3. Describe how analytics can be used to help justify controls modernization projects

4. Express how to integrate data analytics into legacy control systems, and understand the common pitfalls
Traditional Procurement Approach

**Design**
- Mechanical Engineer and/or Architect is the first consultant hired by owner
- Contract documents typically focus on hardware, less on results
- Cx Provider hired to commission systems identified by design engineer

**Bid**
- Cx Provider scrambles to incorporate commissioning requirements into contract documents
- Little time available to identify issues before project is released for bids

**Build**
- Functional Testing happening while contractors and owner are getting anxious
- Finger pointing and change orders
- Schedule delays and budget overruns
Using MBCx to Define Project Scope

Development & Planning
- Cx Provider is first consultant hired by owner
- Cx Provider develops OPR and MBCx Guideline
- Focus on desired outcomes, not hardware upgrades

Diagnostics Testing
- MBCx platform deployed
- Preliminary system testing
- Project Deficiency Report (PDR) populated to inform OPR.

Design
- Contract documents developed based on updated OPR
- Cx Provider reviews contract documents
- Less contingency required as most issues have already been identified

Build
- Testing happens in parallel to construction instead of at the very end
- Fewer change orders
- Cost effectively transition monitoring into warranty period
MBCx Saves Time and Money

Source: WBDG, www.wbdg.org
The MBCx Advantage

- Mitigates Schedule issues
- Less finger pointing
- Mitigates budget issues
- Proactively find issues as they arise

Project scope properly defined
Fewer change orders
Timely resolve issues
Persistent building performance
# Process vs Technical Commissioning

<table>
<thead>
<tr>
<th></th>
<th>Process Commissioning</th>
<th>Technical Commissioning</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inspections</strong></td>
<td>CxA reviews inspection forms completed by contractor. Spot checks TAB report and point-to-point.</td>
<td>CxA fills out own forms and performs 100% point-to-point. No sampling</td>
</tr>
<tr>
<td><strong>Functional Performance Test</strong></td>
<td>Tests are performed and documented by contractors.</td>
<td>CxA personally tests or helps contractor test all systems. Follows up till issue is resolved.</td>
</tr>
<tr>
<td><strong>Completion</strong></td>
<td>Cx Report verifies that building has been commissioned but does not ensure functional building</td>
<td>CxA is able to look owner in the eye and say “Your building is complete and functions as designed”</td>
</tr>
</tbody>
</table>
Step 1. Establish Goals

- System Level
- Building Level
- Portfolio Level
Step 2: Establish Key Performance Indicators

How will you measure success?

- Reduced Energy Cost
- Reduced Occupant Complaints
- Reduced work orders and maintenance cost
Step 3: Organize Your Automation Data

It’s your data!

Normalize data and give it meaning

Find issues that standard alarm consoles can’t
Step 4: Identify Issues Early

<table>
<thead>
<tr>
<th>Rules</th>
<th>dur</th>
<th>priority</th>
<th>severity</th>
<th>Timelines</th>
</tr>
</thead>
<tbody>
<tr>
<td>AHU Economizer Not Optimized</td>
<td>23.93hr</td>
<td>360</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>No change in sensor value</td>
<td>240hr</td>
<td>360</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Boiler Failure or Alarm</td>
<td>6.76hr</td>
<td>360</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Boiler Or Chiller Pump Mismatch</td>
<td>6.39hr</td>
<td>360</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Chiller Failure or Alarm</td>
<td>21.53hr</td>
<td>360</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Chiller Short Cycling</td>
<td>11.47hr</td>
<td>360</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Cycling Damper, VFD Speed or Valve</td>
<td>5hr</td>
<td>15</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Fan failed</td>
<td>4.36hr</td>
<td>8.726</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Fan in hand</td>
<td>12.72hr</td>
<td>63.58</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>High discharge air temp</td>
<td>6.42hr</td>
<td>10.29</td>
<td>1.604</td>
<td></td>
</tr>
<tr>
<td>No change in sensor value</td>
<td>70.75hr</td>
<td>97.5</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Sensor out of range</td>
<td>24hr</td>
<td>48</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Valve leaky</td>
<td>5.75hr</td>
<td>33.47</td>
<td>5.82</td>
<td></td>
</tr>
</tbody>
</table>

Targets:
- AHU-35
- AHU-38 (UMF MAU) CLG1-0
- AHU-5
- AHU-7
- AHU-28 FILTER DP
- Boiler 4
- Chiller 3
- (10)
- (2)
Step 4: Identify Issues Early

Decide what issues should be included in project or what issue will be resolved by maintenance staff before the project begins
Step 4: Identify Issues Early

Determine why control valves are failing prematurely before replacing them…
Step 4: Identify Issues Early

Brand new chiller short cycling. Compressor staging needs to be addressed as part of the controls upgrade.
Step 4: Identify Issues Early

Fixing faulty sensors can now be included in control vendor’s scope from the start
Step 5: Integrate PDR into OPR

Owner knows what they’re getting and contractor knows what they’re bidding on

Will data need to be remapped into analytics engine after upgrade? All data needs to be named/tagged consistently

Put in the project specifications and plan heavy coordination with controls vendor
Step 6: Continuous Testing During Construction

1. Translate FPT into set of scripts. Determine what conditions will be tested and what rules will be used to test.
2. Field verification still required for quality assurance.
3. Streamlined deficiency log updating.
4. Streamlined back checking and verification.
5. Clean transition into warranty period.
Step 7: How did we do?

- Go beyond occupant surveys
- Quantify and track comfort metrics
- Monitoring & Verification
- Energy & Maintenance cost
- Prove the value of commissioning
Need to Standardize Before Considering Automating

Standardization

Automation?

ASHRAE Guideline 36 – Standardized Sequences and Functional Testing Procedures
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