Fault Detection and Diagnostics: Enabling Data Driven Building Operations with Smart Technology

BOMA March 21, 2019
1. Define the concept of fault detection and diagnostics (FDD)
2. Identify the major market trends driving customer need for automated building analytics/performance based analytics solutions
3. Name the outcomes and benefits of automated fault detection and diagnostics (FDD)
4. Define how automated building analytics solutions work including the systems architectures and manage services that support it
5. Describe the key components needed to specify FDD
6. Define how FDD can be leveraged for ongoing monitoring based commissioning programs
7. Identify the functionality, reporting and results available based on a demonstration of a fault detection and diagnostics tool that is currently available
8. Identify typical examples of FDD results based on 3 actual case studies
From Data to Impact

The path to uncovering the “Aha” moments.

Data + Information + Knowledge + Insight + Action = Impact
Think about it.

The convergence of IT and OT is bringing clear tangible advantages to companies

IT-OT is creating strategic opportunities for new efficiencies across the enterprise and new procurement methodologies

Many organizations are balancing their facilities OT and IT investments

Source: Cisco IBSG, April 2011
Change the Game

Enhance business performance

*OT delivered as a service*

A more agile, competitive enterprise

*Cost transparency; flexible infrastructure*

Reduce cost of operations and energy

*New controls in the hands of consumers*

Increase enterprise security

*Integrated approach to external threats*
Proactive Maintenance
Financial Benefits

- Total Cost of Ownership - TCO - reduction
- Better planning for Capex
- Opex budget optimization

TCO Savings in Maintenance

Life Cycle Costs

Downtime Costs

Static Time Based Maintenance

Condition Based Maintenance

Dynamic Time Based Maintenance

Reactive Maintenance

Downtime Costs

Asset Digitization
Conditioned Based Maintenance
Evolving beyond traditional maintenance practices to leverage IOT to become predictive

• Traditional maintenance fails to address almost 80% of failures preventively.
• Use smart assets, sensors, connectivity and FDD to predict eminent failure and act just in time.
• Automated Fault Detection and Diagnostics (FDD) monitors thousands of sensors, comparing actual operation against expected based on site-specific sequences to predict faults and identify better operating methods.
• BEST PRACTICE: Utilizing FDD and conditioned-based maintenance within service plans maximizes the impact of service maintenance spend.

ARC studies show only 18% of asset failure is age related. Based on these data, preventive maintenance provides a benefit for just 18 percent of assets, and monitoring for Predictive maintenance is recommended option for the rest.

FDD for Sustainability is…

…turning big data into actionable insight.

…continuous commissioning through analysis of trends, patterns and changes in the data.

…dashboards that suggest useful information while requiring little understanding or manipulation of the underlying data.

…finding faults where no alarms exist
Critical facility management drivers are impacting all industries

- Sustainability
- New technology
- Labor conditions
- Aging facilities
- Risk management
- Outsourcing
Daily challenges

• Occupant comfort
• Complex building systems
• Shortage of personnel and operator training
• Minimal available budget
• Not all buildings and systems deliver on their capabilities
• Need for ROI-justified decision making

Actionable information is required – not just lots of building data…
FDD Analytics

A managed service that provides …

– Prioritized asset optimization recommendations
– Expert guidance with actionable information
– Results that improve occupant comfort and building energy and financial well-being
– Based on statistical analysis, expert review, performance trending, and diagnostics
What can it find?

Looks at individual equipment and whole systems to identify faults and opportunities for improvement

Example of findings:

- Simultaneous heating and cooling
- Manual overrides
- Excess reheating
- Trends in chiller efficiency
- Short cycling
- Leaking valves, broken dampers
- Opportunity for higher/lower loop setpoints
- Opportunity for static pressure reset
- Suboptimal economizer controls
- Poor occupancy scheduling
- Excessive zone temperature setpoints
- Recurring alarms
- Duration of alarms

+ Custom analytics
Example of fault detection and diagnosis output (simplified)

<table>
<thead>
<tr>
<th>Building</th>
<th>Cluster</th>
<th>Equipment</th>
<th>Fault &amp; Diagnosis</th>
<th>Priority</th>
<th>Est. Savings*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building 58</td>
<td>Cluster E</td>
<td>AHU-012</td>
<td>Leaking chilled water value</td>
<td>High</td>
<td>$11,291</td>
</tr>
<tr>
<td>Building 58</td>
<td>Cluster E</td>
<td>AHU-003</td>
<td>Damper position fault</td>
<td>High</td>
<td>$4,782</td>
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<tr>
<td>Building 58</td>
<td>Cluster E</td>
<td>VAV-022</td>
<td>Over cooling</td>
<td>High</td>
<td>$2,235</td>
</tr>
<tr>
<td>Building 58</td>
<td>Cluster E</td>
<td>CHI-002</td>
<td>Changes to set points</td>
<td>Medium</td>
<td>$895</td>
</tr>
</tbody>
</table>

*Estimated savings potential, expressed as an annual cost of wasted energy if not fixed.*
Monitor, detect, diagnose, and identify energy savings opportunities

How does it work?
Proactive and Preventative Maintenance

- Analytics aren’t alarms. Analytics aren’t reports. Analytics are results – specific findings of operational issues presented to the user in clear understandable views – views that tell us exactly what the issue is, when it occurred, how long it lasted, the status of all related operating conditions, and even the cost impact of the issue.

- Analytics enables you to find patterns and issues you weren’t aware of – patterns that you didn’t expect or couldn’t have imagined. Analytics provide results that show how your building systems really operate versus how you thought they were operating.
Custom reporting

Know the WHY and its impact:

• **Expert Opinion** – Avoidable costs and total savings for period, plus analyst commentary on building operating issues

• **Trend Summary** – Cost/reduction plus C+E+M (comfort, energy, maintenance) trends
Custom reporting

Know the WHY and its impact:

- **Top 5 Issues** – Prioritized C+E+M issues with cost or severity ratings

- **Recommended Actions** – Hit list of clear recommendations
Custom reporting

Know the WHY and its impact:

• Performance Trend – Trend analysis over time to track performance
Complements existing BMS

- Integrates building systems
- Reacts to current state conditions
- Performs control tasks as designed
- Provides notification of nonconformance or exceeding threshold settings

Ideal for operations & maintenance
Maintain day-to-day building operations

FDD Analytics

- Adds data analysis
- Identify recurring performance issues
- Provides ROI prioritization of issues
- Ongoing support from experienced building engineers

Ideal for engineering planning
Pinpoint top comfort, energy, and maintenance (C+E+M) priorities that can maximize O&M resources
Benefits

Reduce major equipment energy spend by 15% to 30%

- **Actionable intelligence**: Automated fault detection and diagnostics (FDD) – prioritized and available anytime, anywhere

- **Centralized expert support**: Centralized system for continuous monitoring-based commissioning (MBCx) to improve and sustain optimal operations

- **Measureable results**: Information, not just data, coupled with visualization that delivers real-time results for fact-based ROI decision making
Summary of FDD Analytics

- Reduces energy spend by **15% to 30%**
- Automated fault detection and diagnostics
- Detailed reports and graphs
- Performance-based utility incentives
- Positive ROI in months
- Lowers carbon footprint
- Increases portfolio value

Provides real impact on energy costs, operational efficiency, occupant comfort, and financial well-being of your buildings