



Making the Most of Existing Healthcare Facility HVAC Systems

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Better Performing E

Agenda

- Introduction
- Retro-Commissioning Process
- Common Low Cost/No Cost Opportunities
- Cost of Retro-Commissioning
- Making it Business-as-Usual



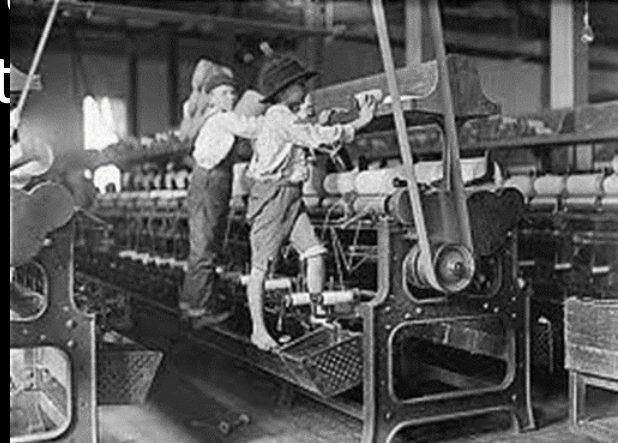
Introduction

- Healthcare Facilities are Excellent Candidates for Energy Savings
 - 24/7 operation
 - Ventilation, heating, cooling, and humidity requirements
 - Sophisticated controls
 - Inherently high energy users
- Retro-Commissioning
- Enhanced Preventive Maint



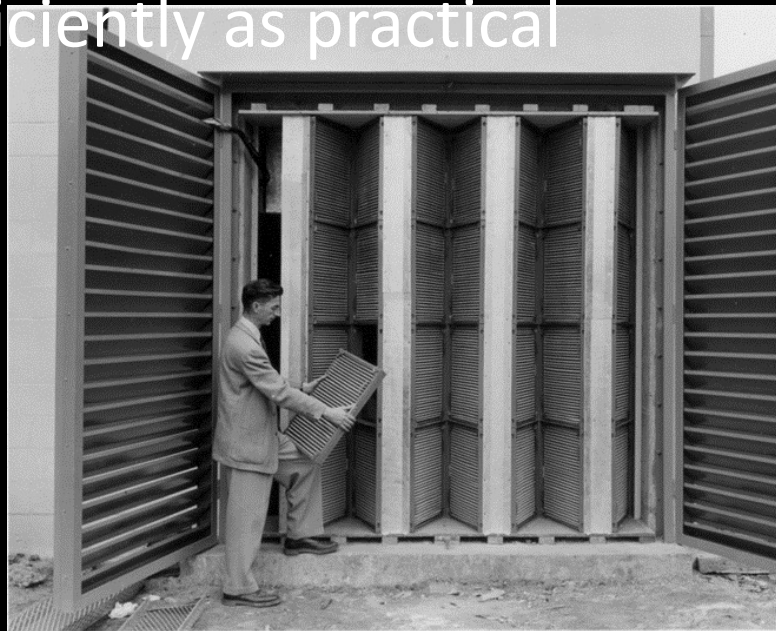
Retro-Commissioning Process

- Retro-Commissioning is:
 - A process by which existing facility system performance is evaluated against the **owner's needs** and adjusted and **optimized** to meet the functional performance criteria.
 - A process that focuses on **DYNAMIC system** operation instead of static installation.



Retro-Commissioning Process

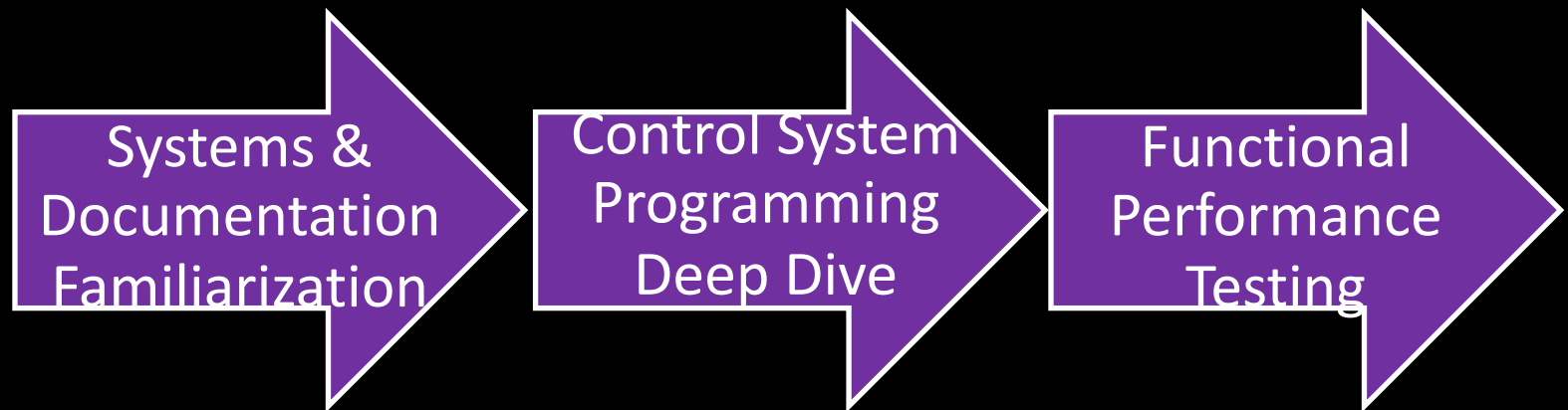
- Retro-Commissioning is Verifying Systems Perform as...
 - Effectively as desired
 - Efficiently as practical



- Environmental controls
- Ventilation
- Lighting
- Electrical power
- Energy management
- Life safety systems
- Process systems



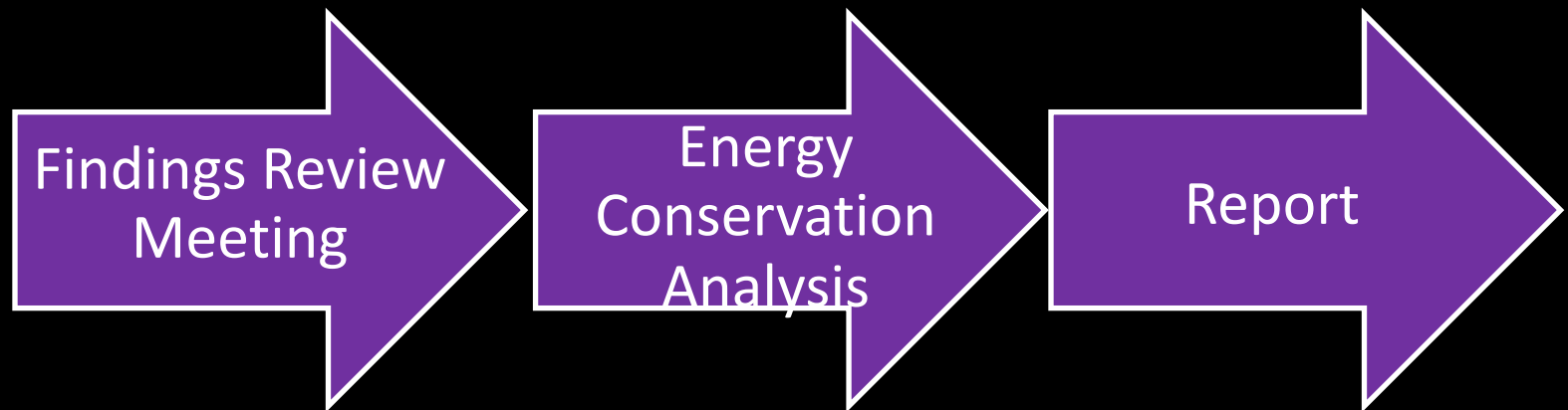
Retro-Commissioning Process



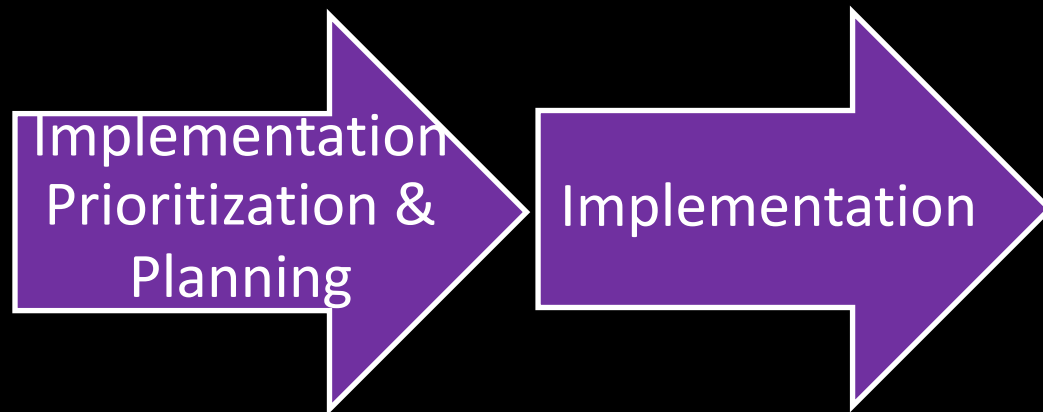
Retro-Commissioning Process



Retro-Commissioning Process



Retro-Commissioning Process



Common Low Cost/No Cost Opportunities

- Exhaust Air
 - Too much exhaust
 - Unnecessary exhaust
- Outside Air
 - Too much outside air
 - Too little outside air



Common Low Cost/No Cost Opportunities

■ Time-of-Day Scheduling

– Air handling units

- Entire system on/off control
- Partial system dampers open

– VAV terminal units

- Temperature setpoint adjustment
- Airflow setpoint adjustment



Common Low Cost/No Cost Opportunities

- Simultaneous Heating & Cooling
 - Leaking-past control valves
 - Un-tuned control loops
 - Individual systems fighting each other



Common Low Cost/No Cost Opportunities

■ Unoccupied Spaces

– Temperature setpoints

- Increase/decrease setpoints
- Expand dead bands between heating and cooling

– Fan-coil unit controls

- 2-position heating/cooling
- Non-continuous fan operation



Common Low Cost/No Cost Opportunities

- Air-Side Economizers
 - Malfunctioning dampers
 - Dry-bulb vs. enthalpy control
 - Mixed air temperature control vs. discharge air temperature control
 - Sensor calibration
 - Malfunctioning rooftop



Common Low Cost/No Cost Opportunities

- Failed Hardware
 - Valves leaking past
 - Dampers not closing
 - Sensors out of calibration



Cost of Retro-Commissioning

- Cost Influences
 - Quantity & complexity of systems
 - Expertise & involvement of O&M staff
 - Documentation availability
 - Computer-based vs. local controls
 - Duration of the retro-commissioning process



Cost of Retro-Commissioning

| Project Type | Size (1,000 sq ft) | Cost (\$/sq ft) |
|-----------------|--------------------|-----------------|
| Laboratory | 10 | 1.00 |
| Office | 20 | 0.25 |
| Laboratory | 30 | 2.50 |
| Office | 60 | 0.42 |
| Office | 150 | 0.27 |
| Office with TES | 160 | 1.25 |
| Multi-Building | 360 | 0.17 |
| Office | 390 | 0.10 |
| Office | 400 | 0.19 |

Association of State Energy Research Technology Transfer Institutions
and the U. S. Department of Energy



Cost of Retro-Commissioning

| Building | Cost | Savings/ Year | Payback (Years) |
|-------------------------|-----------------|--------------------------|----------------------------|
| Highrise Office | \$12,745 | \$8,145 | 1.6 |
| Medical Facility | \$24,000 | \$63,502 | 0.4 |
| Computer/Office | \$28,000 | \$30,385 | 0.9 |
| Retail | \$52,336 | \$42,500 | 1.2 |

E-source study of 44 building ranging from 80,000 to 887,000 sq ft.
Includes investigation, report, and implementation costs



Making it Business-as-Usual

- Enhanced Maintenance Activities
 - Add to preventive maintenance work order system
 - Frequency customized to:
 - Criticality of the system



- Sensor Calibration Checks
- Device Actuation Checks
- BAS Trend Graphs
- BAS Smart Alarms



Making it Business-as-Usual

- Sensor Calibration Checks
 - Example valuable sensors
 - Air handling systems
 - Outside air temperature and relative humidity
 - Mixed air temperature
 - Discharge air temperature and relative humidity
 - Hydronic systems
 - System differential pressure
 - Supply water temperature



Making it Business-as-Usual

- Device Actuation Checks

- Example valuable devices

- Air handling systems

- Outside air dampers

- Return air dampers

- Relief air dampers

- Hydronic systems

- Control valves at coils and heat exchangers

- Bypass control valves for system pressure or minimum flow control



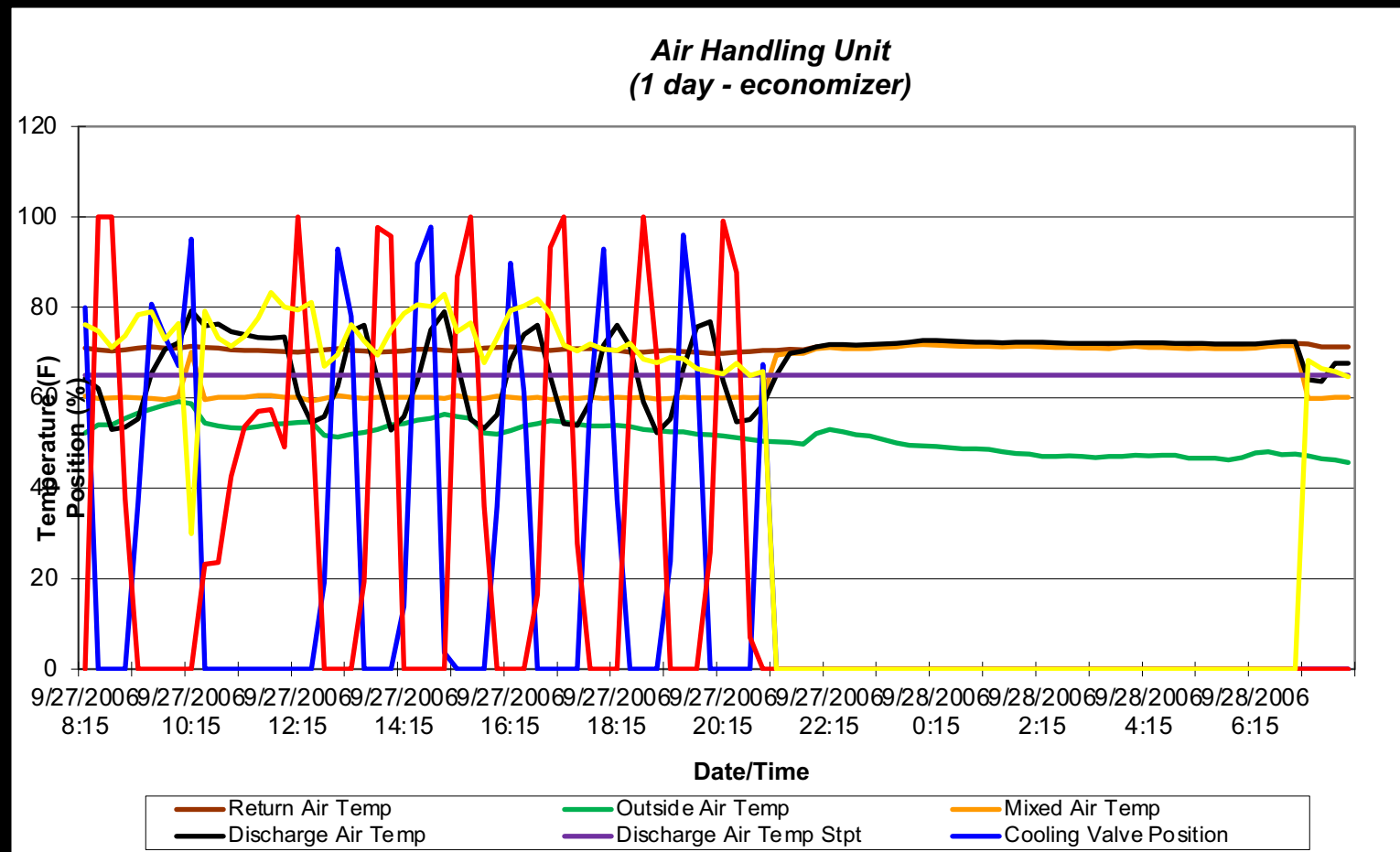
Making it Business-as-Usual

- Building Automation System Trend Graphs
 - Use data to discover trouble spots before the occupants do
 - Analyze data clues to understand the root causes that need to be addressed
 - Identify wasted energy not otherwise discovered
 - Example
 - Overheating hot water control valve
 - Overcooling chilled water valve
 - \$12,500/year energy impact



Making it Business-as-Usual

■ Building Automation Trend Graph - Example



Making it Business-as-Usual

- Building Automation System Smart Alarms
 - Program BAS to automatically find and alarm problem conditions when they occur
 - Identify problem conditions that might otherwise be found through trend log analysis



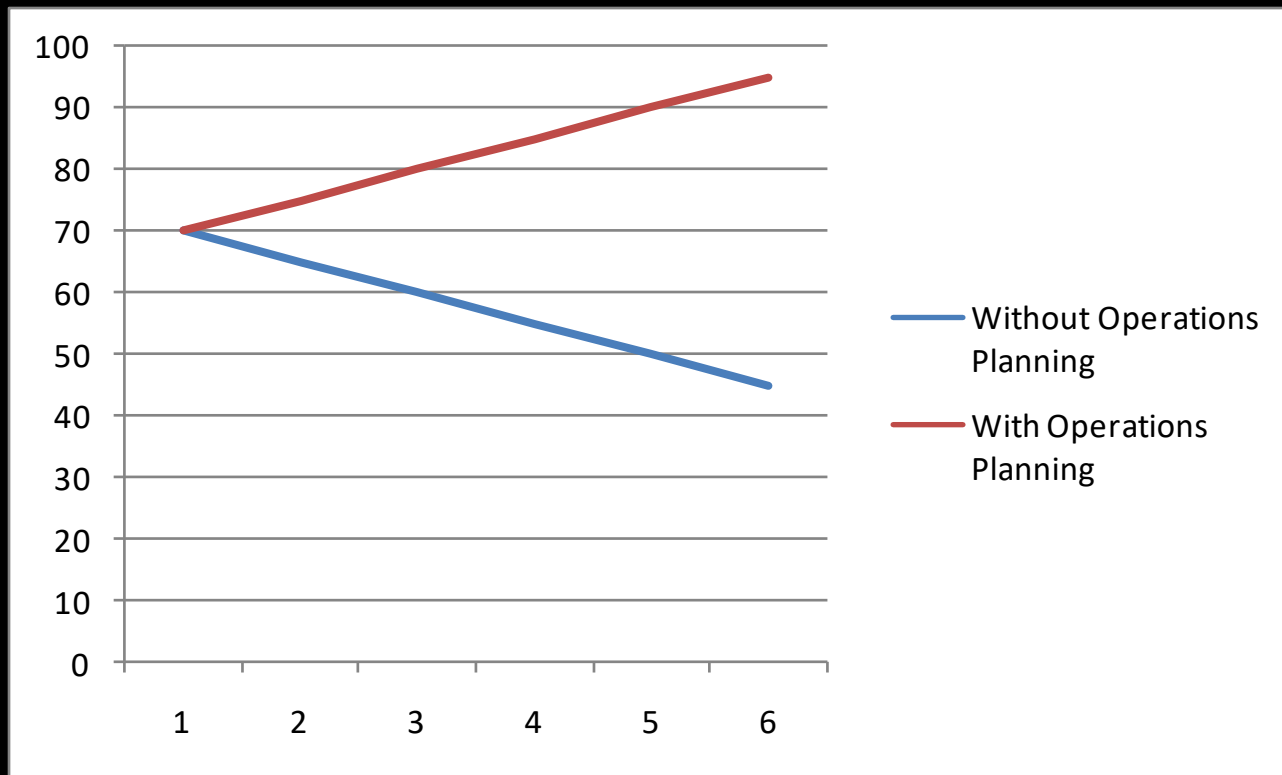
Making it Business-as-Usual

- Building Automation System Smart Alarms - Ideas
 - Variable frequency drives (VFDs) running at 100% speed for more than 24 hours? 1 week?
 - Variable air volume (VAV) terminal units with dampers 100% open for more than 24 hours? 1 week?
 - Any controlled device at 100% signal for more than 24 hours? 1 week?
 - AHU heating and cooling valves open simultaneously
 - Heating coil discharge air temperature higher than



Making it Business-as-Usual

- Sustained Efficient Operation



Discussion

**Questions & Solutions[®]
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