AGENDA

Module 1 - Introduction
Module 2 - Preventative & Deferred Maintenance
Module 3 - Compliance
Module 4 - Facilities Budgets & Resource Planning
Module 5 - Design & Construction
Module 6 - Total Cost of Ownership
Module 7 - Review
WELCOME
INTRODUCTION
INTRODUCTION

University Facilities

- Operations & Maintenance
- Environment, Health & Safety
- Campus Planning
- Design & Construction
- Finance & Administration
- Sustainability & Energy Management
KEY TRENDS

- Aging infrastructure
- Decreasing budgets, increasing growth
- Decreasing budgets, increasing compliance
- Decreasing funding, increasing campus expectations
- Recruitment & Workforce Planning
GROUP ACTIVITY

What would you like to know about Facilities?
PREVENTATIVE & DEFERRED MAINTENANCE
TYPES OF MAINTENANCE

- **PREVENTATIVE**
  - Planned

- **REACTIVE**
  - Unplanned

- **DEFERRED**
  - Cumulative

- What is it?
- CMMS tools?
THE MAINTENANCE CYCLE

As the **deferred maintenance** backlog grows, the risk of system failure increases.

As systems fail, Facilities must dedicate resources to **reactive maintenance**, leaving fewer resources for preventive maintenance.

Dedicating fewer resources to **preventive maintenance** increases the amount of deferred maintenance.
CONCLUSION.....

The Best Offense Is a Good Defense
Preventive Maintenance Almost Always a High-Return Investment

Return on Investment of Maintaining Assets

$1 to $2.73  Estimated relationship between investment in preventive maintenance and avoided future reactive maintenance costs
(BASIC) COMPONENTS OF A PM PROGRAM

- A culture of stewardship
- Dedicated PM Team
- Computerized Maintenance Management Software (CMMS)
THE REALITY OF DEFERRED MAINTENANCE

35% of current space built in Post-WWII construction boom between 1960 and 1975

31% of current space built since 1995; newer buildings are more complex and require more frequent upgrades
THE REALITY OF DEFERRED MAINTENANCE

Average Deferred Maintenance Backlog per Square Foot

Private Institutions (USD)

- 2000: $76
- 2007: $88

Public Institutions (USD)

- 2000: $87
- 2007: $108

Canadian Institutions (CAD)

- 2000: $20
- 2007: $45

Private institutions have seen a 16% increase in the DM backlog per square foot from 2007 to 2015—8.6% faster than inflation.

Public institutions have seen a 24% increase in their DM backlog per square foot from 2007 to 2015—66% faster than inflation.

Canadian institutions have seen a 56% increase in their DM backlog per square foot from 2000 to 2015—70% faster than inflation in Canada.
(BASIC) COMPONENTS OF A DM PROGRAM

- Facility Condition Audit
- Asset Management Tool
- Dedicated staff to maintain data
UB EXAMPLE

- Capital Plan
- University Strategic Initiatives
- Deferred Maintenance
COMPLIANCE
REGULATING BODIES

**Federal**
- Association for Assessment & Accreditation of Lab (AAALAC)
- Centers for Disease Control (CDC)
- Department of Agriculture (USDA/APHIS)
- Department of Alcohol, Tobacco and Firearms (ATF)
- Department of Defense (DOD)
- Department of Health & Human Services (DHHS)
- Department of Homeland Security (DHS)
- Department of Labor
- Department of Transportation (DOT)
- Drug Enforcement Agency (DEA)
- Environmental Protection Agency (EPA)
- Federal Aviation Administration (FAA)
- Federal Bureau of Investigation (FBI)
- Food and Drug Administration (FDA)
- International Air Transport Association (IATA)
- National Institute of Health (NIH)
- Nuclear Regulatory Commission (NRC)
- Occupational Safety & Health Administration (OSHA)

**NY State**
- Department of Environmental Conservation (DEC)
- Department of Health (DOH)
- Department of Labor (DOL)
- Public Employee Safety & Health Bureau (PESH)

**Local/Municipality**
- Buffalo Sewer Authority
- County Local Emergency Planning Committee (LECP)
- Erie County Department of Health
- Erie County Disaster Preparedness Advisory Board
- Town of Amherst
FACILITIES BUDGETS & WORKFORCE PLANNING
BALANCED BUDGET

University at large

- Reputation/Branding
- Student Experience
- Reduce funding

Facilities

- Labor (O/T)
- Maintenance
- Infrastructure Renewal
- Compliance/Safety
WORKFORCE PLANNING

1:5

One new tradesperson is entering industry for every five retiring

66%
of Generation Z has little to no interest in construction careers

Age Distribution of Facilities Workers, U.S. Average

- 18% Over 55
- 35% 45 - 55
- 47% Under 45

Average Age of U.S. Labor Force

- U.S. Industries: 43
- Facilities Management: 49
# WORKFORCE PLANNING

## Comparison of Scalable Apprenticeships to Formalized Upskilling Programs

<table>
<thead>
<tr>
<th></th>
<th>Scalable Apprenticeship Programs</th>
<th>Formalized Upskilling Programs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Facilities Unit Goal</strong></td>
<td>Develop talent to fill high-demand trades roles</td>
<td>Develop talent to fill high-demand trades roles</td>
</tr>
<tr>
<td><strong>Target Roles</strong></td>
<td>Electrical, plumbing, HVAC</td>
<td>Maintenance technician, structural trades, plant utilities assistant</td>
</tr>
<tr>
<td><strong>Training</strong></td>
<td>Combination of on-the-job learning and related technical instruction</td>
<td>On-the-job learning required; related technical instruction optional</td>
</tr>
<tr>
<td><strong>Target Audience</strong></td>
<td>Internal or external candidates</td>
<td>Primarily internal candidates (e.g., custodial, grounds, helpers)</td>
</tr>
<tr>
<td><strong>Length</strong></td>
<td>Typically, 3-6 years</td>
<td>Typically, 1-3 years</td>
</tr>
<tr>
<td><strong>Outcome</strong></td>
<td>Participants earn industry-recognized credentials</td>
<td>Participants develop skills required to meet institution-specific trade needs</td>
</tr>
</tbody>
</table>
DESIGN & CONSTRUCTION
PROJECT PHASES

- Planning/Scoping
- Design
- Construction
- Turnover
- Operation
PROJECT PHASES - PLANNING

• Planning phase is **key** to any project success
  
  • **SCOPE**: What are we trying to achieve? What kind of space?
  
  • **BUDGET**: How much money do we have to spend?
  
  • **SCHEDULE**: When do you need it?
PROJECT PHASES - DESIGN

- Four phases
  - PROGRAMMING: refine scope of work
  - SCHEMATIC DESIGN: mechanical, electrical, plumbing, structural
  - DETAILED DESIGN or DESIGN DEVELOPMENT: 30%, 60%, 90%
  - CONSTRUCTION DOCUMENT: bid issuance
COST ESTIMATES
PROJECT PHASES - CONSTRUCTION

• Construction delivery methods
  • Design-bid-build (DBB)
  • Construction manager at risk (CMAR)
  • Design-build (DB)
  • Public-private-partnership (P3, PPP)
PROJECT PHASES – TURNOVER

• Turnover Checklist Items
  • As-Built Drawings
  • Commissioning Reports
  • Systems Manuals
  • Replacement Materials
  • Training of Operations & Maintenance Staff
PROJECT PHASES - OPERATIONS
TOTAL COST OF OWNERSHIP
**TOTAL COST OF OWNERSHIP COMPONENTS**

**Total Cost of Ownership Makes a Disciplinary Leap**

<table>
<thead>
<tr>
<th></th>
<th><strong>IT Application</strong></th>
<th><strong>Facilities Application</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>High Visibility</strong></td>
<td>• Hardware and software (e.g., acquisition, maintenance contracts)</td>
<td>• First costs (e.g., planning and design, construction, commissioning)</td>
</tr>
<tr>
<td></td>
<td>• Operations (e.g., central labor, network, facilities)</td>
<td>• Replacement and renewal (e.g., renovation, program upgrades)</td>
</tr>
<tr>
<td><strong>Low Visibility</strong></td>
<td>• Administration (e.g., finance, procurement)</td>
<td>• Operations and maintenance (e.g., maintenance program, custodial and grounds)</td>
</tr>
<tr>
<td></td>
<td>• End-user operations (e.g., productivity lost to troubleshooting)</td>
<td>• Utilities (e.g., electricity, gas, water, renewables)</td>
</tr>
<tr>
<td></td>
<td>• Downtime (e.g., productivity/revenue lost to inoperable hardware or software)</td>
<td>• End-of-life (e.g., demolition and disposal)</td>
</tr>
</tbody>
</table>
TOTAL COST BREAKDOWN

Quantifying the Total Cost Breakdown

EAB’s Total Cost of Ownership Model

- **Recurring Operations and Maintenance**: 38%
  - Range: 30-58%

- **Periodic Recapitalization and Renewal**: 29%
  - Range: 18-39%

- **Planning, Design, and Construction**: 31%
  - Range: 13-43%

- **End-of-Life**: 2%
  - Range: 1-3%

Source: EAB interviews and analysis.
TCO MINDSET

Our Focus Today
Building a Total Cost of Ownership Mindset

Guardrails to Enforce Better Decisions Across All Capital Projects
Tactic 1: Maintain Accessible and Enforceable Design Guidelines That Balance Manufacturer Specifications and Performance Criteria
Tactic 2: Document Design and Construction “Lessons Learned” to Avoid Common TCO Missteps and Secure Easy Wins
Tactic 3: Advocate for Board-Backed Capital Project Policies That Look Beyond First Costs to Total Costs

Pre-Occupancy Interventions to Lower Recurring Costs of Capital Projects
Tactic 4: Amplify the O&M Perspective in Project Design (as an Antidote to “Value Engineering”)
Tactic 5: Pull Forward Commissioning to Minimize Early-Occupancy O&M Costs
Tactic 6: Establish Building Handoff Expectations that Simplify O&M Activities in Early Occupancy

Post-Occupancy Strategies to Manage Energy Costs of New and Existing Infrastructure
Tactic 7: Correct for Inevitable Energy Drift with Targeted Recommissioning
Tactic 8: Invest in Energy Retrofits to Secure Greater Utilities Savings and Reset Building Efficiency
Tactic 9: Scale Up Investments in Continuous Commissioning Teams and Technologies
PERFORMANCE BASED SPECIFICATIONS

Sample Prescriptive v. Performance-Based Prompts

From Prescriptive to Performance-Based

<table>
<thead>
<tr>
<th>Performance/Prescriptive Mix</th>
<th>Sample Guidelines Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fully prescriptive</td>
<td>Provide Door Category Number 123 from Fantastic Door Company</td>
</tr>
<tr>
<td>Prescriptive with some performance criteria</td>
<td>Provide timber rectangular door 1800 x 800 x 40mm with dead lock capable of resisting a horizontal force of 2kN</td>
</tr>
<tr>
<td>Performance with some prescriptive criteria</td>
<td>Provide lockable 1800 x 800mm door capable of resisting intruder with crow bar</td>
</tr>
<tr>
<td>As a sub-system with performance and interface requirements</td>
<td>Provide controlled access to fit 1800 x 800mm opening in wall with appropriate security measures</td>
</tr>
<tr>
<td>As a sub-system with performance requirements only</td>
<td>Provide controlled access suitable for average Sumo wrestlers with appropriate security measures</td>
</tr>
<tr>
<td>As part of a total system in risk based performance terms</td>
<td>Provide controlled access for Ali Baba and the 40 Thieves that 90% of occupants will be happy with</td>
</tr>
</tbody>
</table>

Prompts for Frontline Staff to Articulate Design Preferences

- What do you need from this product or asset?
- How would you define acceptable performance from the asset? What do you expect it to do?
- What about unacceptable performance? What should it absolutely not do?
- How should we measure the performance of this asset? What do you look for when monitoring it or performing maintenance?
- How can we translate that performance measurement into technical criteria?
POST OCCUPANCY EVALUATIONS

Tactic 2: Document Design and Construction “Lessons Learned” to Avoid Common TCO Missteps

Missed Opportunities Between Guideline Refreshes

3 average number of construction projects per year

17 average number of renovations per year

6 average years between design guidelines revisions

120 capital projects’ worth of lost insights

Stevens Institute of Technology’s Solution: Create a Lessons Learned Document

- At closeout, project managers collect suggestions for future projects from design and construction stakeholders
- Senior Facilities leaders vet input and incorporate into centrally-managed document
- Document sent to A&E partners before each project with expectation that lessons will be applied to upcoming work
- “Living repository” codifies institutional knowledge and lessons learned during projects at a faster rate than design guidelines updates
BOARD-BACKED TCO POLICIES

Westfield University¹ Prioritizes Programming Over Sustainability in Health Sciences Project

Stakeholder Wishes Granted...

- Department receives eight new MRI machines
- Building entrance features glass atrium with floor-to-ceiling windows
- Advanced technology and multiple projectors in every classroom

...Before Considering Budgetary Impact

- Operational dollars don’t account for machine upkeep or inevitable replacement
- Utilities bill skyrocket and customers complain about windows; Facilities can’t afford to clean
- Occupants struggle to operate complex technology; Facilities brings in contractors to remediate tech issues

“A month after move-in, the dean of the school confessed to me—‘I don’t know how we are going to pay for this building.’”

Senior Facilities Officer
Regional Public Institution

Components of Iowa’s Total Cost of Ownership Policy

- Mandates the use of project components that meet best overall life-cycle investment
- Requires project budgets to account for the cost of commissioning
- Earmarks part of project budget to utilities infrastructure growth fund
- Prevents “value engineering” from removing critical redundant systems

Source: EAB interviews and analysis.

¹ University of Iowa’s Policy Embeds TCO Expectations Into Capital Planning and Budgeting
O&M FEEDBACK VS. VALUE ENGINEERING

The House That O&M Didn’t Build

1. Design reviews scheduled at end of schematic design, design development, and construction document phases
2. Design documents circulated to shops and commissioning team with at least two weeks to review
3. O&M staff aggregate written comments in a spreadsheet
4. Design team reviews, discusses, and responds to O&M feedback
5. Feedback reviewed and verified in subsequent design iterations to ensure incorporation

Value-engineered cheaper window glazing leads to higher energy costs
Custodial closets downsized to make room for additional faculty offices
Atrium with high ceiling requires scaffolding to change light bulbs
Control panel located behind walls without access point
Backup steam line removed to lower project cost
High-traffic areas covered with carpet
O&M FEEDBACK VS. VALUE ENGINEERING

Protect O&M Staff Time to Ease Participation
Two Strategies to Ensure Engagement While Avoiding Burnout

1 Schedule (and Track) Staff Involvement in CMMS¹

Use CMMS to create work orders for design review sessions to reserve time and recognize value of O&M contributions

Work orders can also be used to track other capital project-related work of O&M staff, such as construction site walkthroughs

“We open up a work order for every design review to make sure we allocate the necessary time and underscore the value of the task to our O&M teams.”

Craig Short, Former SFO
James Madison University

2 Limit O&M Staff Participation to No More Than One Hour per Week

Setting a limited amount of time O&M staff are expected to review designs helps them prioritize day-to-day maintenance work

Keep meetings and design tasks short and tightly scoped to help staff stay engaged

“When design reviews are scoped, we all win. O&M gives us quality feedback and can contribute without feeling like it’s at the expense of other tasks.”

Senior Facilities Officer,
Regional Private University
THANK YOU!