Three Guardrails to Enforce Better Capital Project Decisions

Building a Total Cost of Ownership Mindset, Part I

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Facilities Forum

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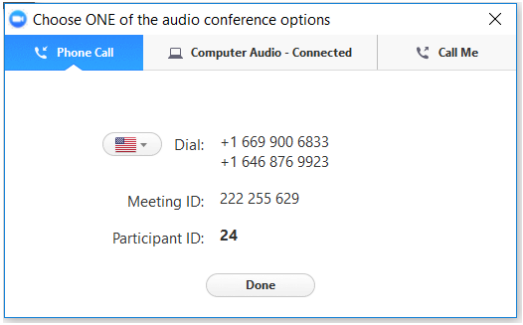

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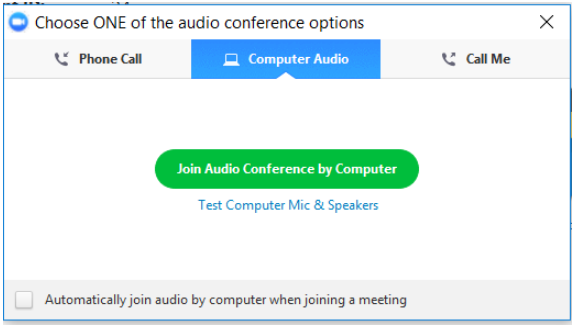

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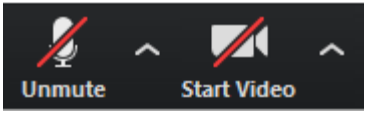

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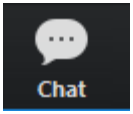

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1) Operations and maintenance.

Source: EAB interviews and analysis.

1 The Case for a Total Cost of Ownership Mindset

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The Proof Is in the Potty

Total Cost of Ownership Evaluation Saves Seattle from a Crappy Investment

Unrolling the Seattle Public Restroom Saga

1. Seattle makes $5M investment in five fully-automated, self-cleaning toilets
2. City leaders sour on the investment as the toilets become havens for illicit activity
3. Destructive use of toilets requires unplanned, unbudgeted daily manual cleanings
4. Automated toilets ultimately sold at a loss on eBay for $12.5K
5. Seattle shifts gears with easier-to-maintain Portland Loo model, designed to maximize safety, access, hygiene, and cost

PORTLANDLOO.COM

> "We're just thrilled we don't have [the automated toilets] anymore. The [savings] is not in their sale, but avoiding the maintenance costs for years and years and years."
>
> *Pat Miller, Seattle's Fleets and Facilities Department*

Source: N Clark, "Seattle's $5 Million Automated Public Toilets Sold for $12,000," *Seattle Times*, August 16, 2008; EAB interviews and analysis.

Total Cost of Ownership: From IT to Facilities

Gartner's Seminal TCO[1] Research for PCs[2] Expands to Wider Application

Gartner

1986 Study Exposes Total Cost of Desktop Ownership in a Distributed IT Culture

- **$7-13K** annual total cost of PC ownership in 1986
- **20%** of TCO is hardware and software acquisition
- **80%** of TCO can be managed via operations

Total Cost of Ownership Makes a Disciplinary Leap

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

1) Total cost of ownership.
2) Personal computers.

Source: L Mieritz and B Kirwin, "Defining Gartner Total Cost of Ownership," *Gartner Research*, December 8, 2005; P Owoche et. al., "Evaluating Total Cost of Ownership for University Enterprise Resource Planning: Case of Maseno University," *IOSR-JCE* vol. 17 no. 2, March-April 2015; EAB interviews and analysis.

Early (But Disjointed) Efforts to Inflect TCO

Institutions Opportunistically Apply Principles to Investments

> Conceptually, TCO makes perfect sense…and it's the right way to think about assets. It's just a shame we can't apply it on campus.
>
> **Senior Facilities Officer**
> REGIONAL PUBLIC UNIVERSITY

Despite Skeptical Tone, TCO-Informed Decisions More Common Than Realized

Facilities places five-year limit on its commitment to maintain donated trees

New campus designed with "no corners" policy to increase efficiency of mowing teams

Single-source safety systems adopted across campus to mitigate life and reputational risk

Total costs analyzed in deciding whether to tear down or renovate a residence hall

Source: EAB interviews and analysis.

In Search of a Grand Unified Theory

SFOs[1] Hunting for Guidance to Measure, Lower, and Communicate TCO

APPA's TCO Standard

> "A holistic approach to maximizing return on investment of managed physical assets that includes the summation of all known and estimated costs to include first, recurring, renewal/replacement, and end-of-useful life costs revised at critical decision points to aid in life-cycle asset management decisions."

ANSI-Approved[2] Standards

- Part 1: 13 Key Principles of Data Collection Efforts *(December 2017)*
- Part 2: Implementation Plan *(Forthcoming in 2019)*

Questions Posed by SFOs

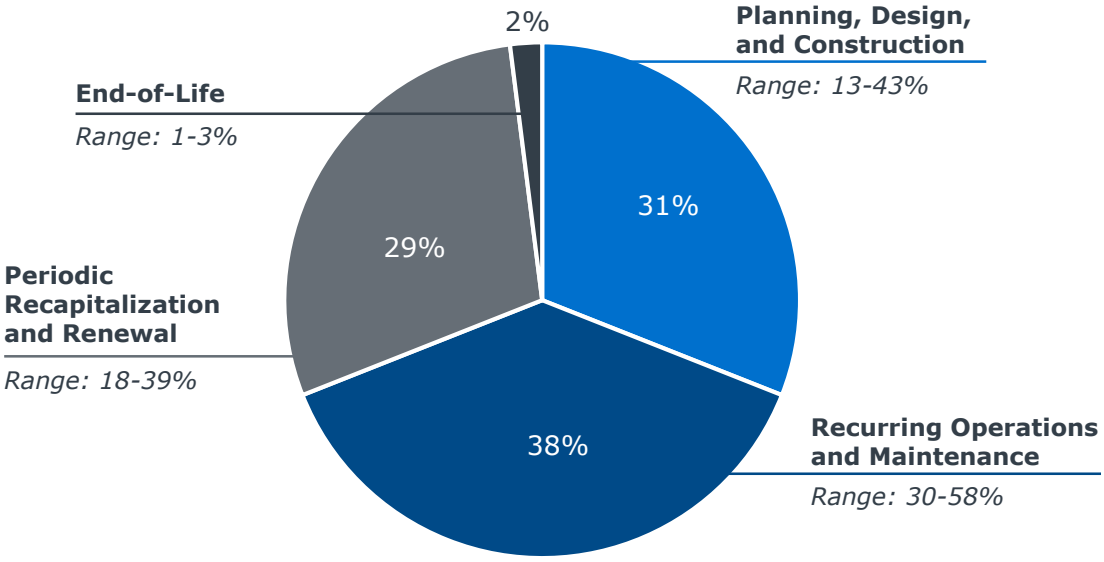
- How can I better approximate TCO once I know a building's first costs?
- What can I do now to ease the long-term operations and energy costs that every new building adds to my budget?
- How do I explain the value of a TCO model to faculty and other project stakeholders who are only concerned with first costs?

1) Senior Facilities officer.
2) American National Standards Institute.

Source: APPA, "1000-1: Total Cost of Ownership for Facilities Asset Management (TCO)—Part 1: Key Principles," December 14, 2017; EAB interviews and analysis.

Quantifying the Total Cost Breakdown

EAB's Total Cost of Ownership Model



Source: EAB interviews and analysis.

Analysis of EAB's TCO Model

Data in Brief

- Historical data from 22 institutions—8 private, 14 public
- Building types include residence halls, labs, and mixed-use
- Only four institutions had decommissioned a building and could report data for that factor

Key Observations from the Dataset

- Distribution of cost buckets is reflective of historical funding trends, not ideal ratios
  - Given growth in "smart" buildings, recapitalization and renewal needs are only expected to increase
- Investments are interdependent, as seen in the wide ranges for each bucket
  - First costs make up a smaller percentage of total costs at institutions with fully funded maintenance programs
  - Alternatively, first costs may be larger when institutions invest in high-quality materials and systems with a longer life cycle (and require less maintenance)

Source: EAB interviews and analysis.

TCO Model Helpful, But Not Sufficient

Numbers Alone Fail to Shift Stakeholders' Decision-Making Framework

Any TCO Model Limited by Complicated Mathematics…

- Necessary asset data not collected, or not collected at the right level (e.g., energy not metered by building)
- Volume and variety of assets on campus (e.g., residence halls, labs) makes direct comparisons difficult
- Seemingly infinite number of variables that can affect TCO calculus (e.g., climate, soil type, hours of operation)
- Accurate projections assume a fully-funded maintenance program, a pipe dream for most institutions

…and Applicability Hindered by Higher Ed Operating Environment

- Senior leaders' short tenure pushes them toward prioritizing building new, not renovating
- Strong influence of faculty preserves programmatic wish list at the expense of infrastructure investments
- Procurement laws may mandate public institutions select products based on lowest cost, not best value
- Opaque relationship between investments in infrastructure and impact on higher ed's version of "ROI"

Source: EAB interviews and analysis.

More Than a Model,
Inflecting TCO Requires a New Mindset

> “Trying to calculate TCO at the start of a capital project will typically leave you frustrated. But aiming for achievable, consensus-driven, strategic decisions on a smaller scale—**on the decisions you can actually influence**—will still have the desired effect on life-cycle costs.”

Michael Perez
Associate Vice Chancellor and Chief Facilities Officer, Vanderbilt University

Source: Vanderbilt University, Nashville, TN; EAB interviews and analysis.

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

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1) Operations and maintenance.

Source: EAB interviews and analysis.

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D.C.'s Public Enemy No. 1

Metro Problems Extend Far Beyond a Deferred Maintenance Cautionary Tale

Doomed Before Leaving the Station

- Built in 1976 with only two tracks, leaving no room for repair crews to work while trains are running
- No dedicated source of operational funding, given unwillingness of lawmakers to propose a special tax
- Budgets allocated toward expansion of lines and stations rather than necessary maintenance
- Leadership made up of political appointees—not transit, managerial, or financial experts

Metro Train Collision in 2009 Results in Nine Passenger Deaths

THE WASHINGTON POST.

Source: R McCartney and P Duggan, "Metro Sank Into Crisis Despite Decades of Warnings," *The Washington Post,* 2016; EAB interviews and analysis.

On the Same Runaway Track?

Higher Ed Facilities Faces Parallel Pitfalls

DC Metro Pitfall	Higher Ed Parallel	TCO Guardrail
Vendors hold contracts for decades, despite performance failings	Architects, stakeholders make design decisions with their own interests (not institutional priorities) in mind	**Tactic 1**: Maintain Accessible and Enforceable Design Guidelines That Balance Manufacturer Specifications and Performance Criteria
Safety problems repeat themselves as workers fear reprisals for pointing out issues to senior management	Easily avoidable mistakes duplicated on multiple projects across campus, wasting time and money	**Tactic 2**: Document Design and Construction "Lessons Learned" to Avoid Common TCO Missteps
No guaranteed source of yearly operating funds	Capital projects approved without considering long-term O&M commitments	**Tactic 3**: Advocate for Board-Backed Capital Project Policies That Look Beyond First Costs to Total Costs

Source: EAB interviews and analysis.

Tactic 1: Maintain Accessible and Enforceable Design Guidelines

Balance Manufacturer Specifications with Performance Criteria

> "Design standards are meant to target the 'best value' for the university. They keep us from demanding a Cadillac on the construction side and keep us from compromising on the operations side."

Don Guckert, AVP Facilities Management
University of Iowa

> "Our design guidelines are 350 pages long—and I'm not sure our contractors think about them as anything other than a doorstop."

Senior Facilities Officer
Private Masters University

Source: University of Iowa, Ames, IA; EAB interviews and analysis.

Maximizing Utility of Design Guidelines

User-Friendly Design Guidelines Promote Easy Reference

Exemplar	Strength	
ASU Arizona State University	**CSI Standard**	**Arizona State University** organizes its guidelines according to the 16 divisions of the Construction Services Institute's (CSI) MasterFormat
University of Virginia	**Brevity**	**University of Virginia** trimmed its guidelines from 323 pages to 144 pages including appendices (a 55.4% reduction) for easier reference
MIT	**Symbols and Colors**	**MIT's** Building Systems Design Handbook has used color-coded symbols to indicate different types of standards (e.g., a red cross for health/safety, a blue wrench for operations)
USC University of Southern California	**Accessible Web Format**	**University of Southern California** has a dedicated design guidelines landing page, with embedded links to each section and the date revised clearly displayed
Brown	**Searchable**	**Brown University's** guidelines have a search bar for ease of navigating the document
University of Michigan	**Linked Documents**	**University of Michigan's** design guidelines link to related documents at the beginning of each section, including other sections of the guidelines

Source: Arizona State University, Tempe, AZ; Brown University, Providence, RI; Michigan Institute of Technology, Cambridge, MA; University of Michigan, Ann Arbor, MI; University of Southern California, Los Angeles, CA; University of Virginia, Charlottesville, VA; EAB interviews and analysis.

How Prescriptive Should the Guidelines Be?

In Most Situations, Push Toward Performance-Based Standards

	Pros	Cons	Best For	Example
Prescriptive	• Only way to have complete control over products used in buildings • Users can closely estimate asset performance and accompanying O&M workload • Keeps surplus stock to a minimum	• Needs frequent updates as technology evolves • Difficult to implement at publics due to procurement regulations • Manufacturers may alter prices or quality	• Key systems that rely on inter-operability or mitigate risk (e.g., security, BAS) • Universities where O&M has little input into capital project decisions	SMU Southern Methodist University moved to a single vendor for all building systems after calculating that this was the most cost-effective move over the course of asset lifetimes
Performance-Based	• Allows standards to continue to be applied even as technology evolves • Allows design team to apply its expertise to find best solution	• Requires purchasers to understand performance requirements • Inferior products can be substituted if wording is unclear	• Most systems on campus • Anywhere sole-sourcing is not necessary or permitted	VANDERBILT UNIVERSITY Vanderbilt's performance-based guidelines use standard industry language for performance expectations of energy assets

Source: Southern Methodist University, Dallas, TX; Vanderbilt University, Nashville, TN; EAB interviews and analysis.

Sample Prescriptive v. Performance-Based Prompts

From Prescriptive to Performance-Based[1]

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

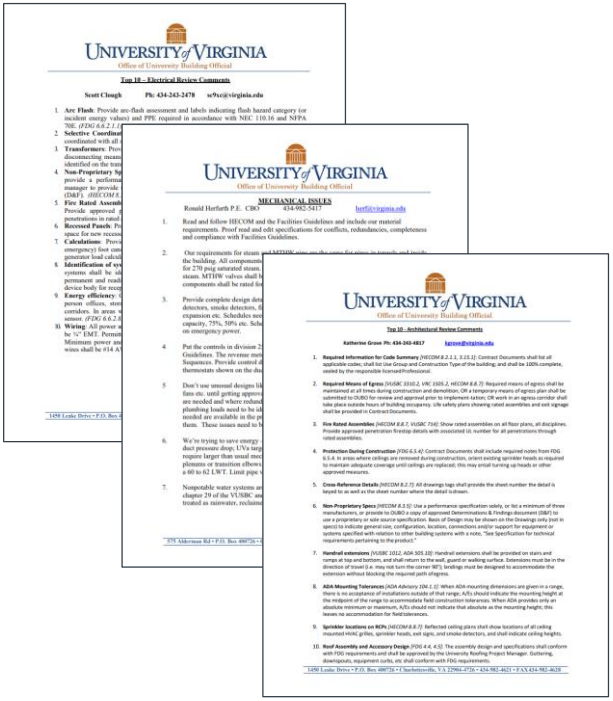
Prompts for Frontline Staff to Articulate Design Preferences

- 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?

1) G Foliente, "Developments in Performance-Based Building Codes and Standards," Forest Products Journal 50(7):12-21, July 2000.

Source: EAB interviews and analysis.

UVA's Top 10 Lists Spotlight Key Design Issues



UNIVERSITY of VIRGINIA

UVA Publishes "Top 10" Lists of Common Mistakes in Project Design Across Key Categories

- Architectural
- Electrical
- Fire Alarms
- Fire Safety
- Fire Sprinklers
- Mechanical
- Structural
- Administrative

Implementation Guidance

- Abbreviated "greatest hits" guidance ensures compliance with critical areas of standards
- UVA regularly updates list to reflect current capital project process

Download UVA's **Top 10 Lists** here.

Source: University of Virginia, Charlottesville, VA; EAB interviews and analysis.

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
THE INNOVATION UNIVERSITY

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

Source: Stevens Institute of Technology, Hoboken, NJ; EAB interviews and analysis.

Avoiding Mistakes of the Past

STEVENS INSTITUTE of TECHNOLOGY
THE INNOVATION UNIVERSITY

Excerpt of Stevens Institute of Technology's Lessons Learned

Category	Representative Comments
Architecture	All convector cabinets are accessible post-construction.
Engineering	Do not locate HVAC equipment for IT rooms in the ceiling—this allows water to enter. Duct in from outside, or use a split system with an evaporator hanging on the wall. Drain evaporator outside the room.
Construction	All infrastructure inside ceilings and walls should be labeled every five feet, including flow direction, for all installed services.

Download Stevens' **Lessons Learned** here.

UAA
UNIVERSITY of ALASKA ANCHORAGE

UAA Captures Lessons in Post-Project Debrief

- What worked well—or did not work well—either for this project or for the project team?
- What needs to be repeated or done differently?
- What surprises did the team encounter?
- What project circumstances were not anticipated?
- Were the project goals attained? If not, what changes need to be made?

Download UAA's **project debrief documentation** here.

Source: Stevens Institute of Technology, Hoboken, NJ; University of Alaska Anchorage, Anchorage, AK; EAB interviews and analysis.

Tactic 3: Advocate for Board-Backed Capital Project Policies That Look Beyond First Costs to Total Costs

Westfield University[1] Prioritizes Programming Over Sustainability in Health Sciences Project

Stakeholder Wishes Granted…		*…Before Considering Budgetary Impact*
Department receives eight **new MRI machines**	→	Operational dollars **don't account for machine upkeep** or inevitable replacement
Building entrance features **glass atrium** with floor-to-ceiling windows	→	**Utilities bill skyrockets** and customers complain about windows Facilities can't afford to clean
Advanced technology and multiple projectors in every classroom	→	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*

1) Pseudonym.

Source: EAB interviews and analysis.

The Gold Standard?

University of Iowa's Policy Embeds TCO Expectations Into Capital Projects

THE UNIVERSITY OF IOWA

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

> Every project suffers from not having enough money. Spelling out a TCO decision framework in an institutional policy serves as a backstop when we have to make tough choices—it's not just about protecting the capital or operating budget, but the university as a whole.
>
> **Don Guckert**
>
> *AVP Facilities Management*
> University of Iowa

Download Iowa's **TCO policy** here.

Source: University of Iowa, Iowa City, Iowa; EAB interviews and analysis.

Policy 1: Prohibit Construction Activities Until Financial Thresholds Are Met

Go/No-Go Policy Sets Baseline for Project Success

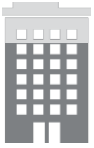
Perils of Building Without Guaranteed Funds

- Funding shortages delay construction, postponing academic programs or residence spaces for students and adding first costs
- Important building redundancies eliminated to make up for budget shortfalls

UNIVERSITY OF NOTRE DAME

University of Notre Dame Establishes 100% Funding Policy in Wake of Dot-Com Crash

- Construction begins on residence hall, but promised gifts fall through when the dot-com bubble bursts
- Leadership fences in the building and stops construction until funds secured
- From this crisis, Notre Dame creates a board-enforced funding policy
- **100%** of a building's first costs must be pledged before initiating construction



25% *pledged funds delivered within five years*

75% *cash in hand on first day of construction*

Download Notre Dame's **Construction Policy** here.

Source: University of Notre Dame, Notre Dame, IN; EAB interviews and analysis.

Policy 2: Require O&M Projections and Funding Plan for Project Approval

Caltech's Project Proposals Must Include First, Recurring Cost Estimates

Caltech

Four Components of Caltech's Capital Project Proposals

1. Description of and justification for the project
2. Project cost estimate
3. Funding plan for project costs
4. Maintenance and operating cost estimate with funding source

Calculator for Projecting Recurring Costs

O&M[1] per GSF[2]
(Source: APPA FPI[3] data)

+

Utilities costs
(Source: Per-GSF utilities cost of a similar building)

+

Capital renewal
(Source: 2-4% CRV[4])

Recurring annual cost projection

Download Caltech's **Capital Construction Guidelines** here.

1) Operations and maintenance.
2) Gross square foot.
3) Facilities Performance Indicators.
4) Current replacement value; recommended by APPA.

Source: California Institute of Technology, Pasadena, CA; EAB interviews and analysis.

Policy 3: Mandate That Capital Project Costs Include Funds for Maintenance/Renewal Endowments

Southern Methodist University

- **Unused contingency funds allocated to an O&M endowment** at project completion
- Contingency funds make up 10% of construction costs
- To maximize endowment, SMU does not allow contingency funds to be used to increase the scope of a project

Oregon State University

- Building occupants required to allocate **10% of direct construction costs to a renewal fund** for the building
- Sponsors can source funds from general department reserves, gifts, or elsewhere
- Renewal fund does not earn interest but does remain with the building rather than occupants

Download EAB's **Maintenance Endowment Compendium** here.

Source: Oregon State University, Corvallis, OR; Southern Methodist University, Dallas, TX; EAB interviews and analysis.

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Register for all future webinars at eab.com.

1) Operations and maintenance.

Source: EAB interviews and analysis.

Any Questions?

Contact Information

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Evaluating Today's Session

Please take a minute to provide your thoughts on today's presentation.

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