

Bending the Curve

Mitigating the Deferred Maintenance Backlog on the AI-Enabled Sustainable Smart Campus

A Companion Briefing to *The Smart Campus Manifesto*

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Executive Summary

Deferred maintenance is not a static number to be reported—it is an escalating trajectory that directly erodes an institution's strategic, financial, and environmental resilience. Today, higher education institutions face a compounding polycrisis of declining enrollment, constricted budgets, and staffing shortages, set against rapidly aging physical infrastructure. Across the sector, the capital renewal backlog has climbed to \$156 per gross square foot, operating budgets sit nearly 19 percent below target, and institutions fund barely 73.5 percent of the reinvestment required merely to keep the liability from growing. Underfunded maintenance is not being managed; it is being scheduled to compound. Yet every arithmetic-driven trajectory can be bent.

To break this cycle, institutions are shifting from backward-looking descriptions of aging assets to disciplined, forward-thinking asset stewardship. Grounded in referenceable practices from campuses nationwide, this briefing translates the principles of *The Smart Campus Manifesto* into eight decisive leadership actions structured across three primary levers:

Disciplined Governance and Unified Capital Authority: Unifying cyber-physical capital budgets under one lifecycle model to fund renewal at the actual rate of asset decay, establishing board-level condition targets, and mandating renewal before expansion.

Portfolio Right-Sizing and Strategic Master Planning: Using data-informed master planning to navigate difficult space conversations, aggressively identifying opportunities to renovate, consolidate, replace, or demolish unneeded square footage to permanently retire liability.

Predictive Operational Intelligence: Deploying modern tools such as Willow's Digital Twin and Operational AI to replace episodic, backward-looking facility condition assessments with continuous telemetry and predictive capabilities that forecast conditions and drive decisions.

These operational technologies provide real-time visibility into facility conditions, dynamic failure risks, and the predictive return on targeted interventions. By directing scarce capital strictly to high-consequence systems showing algorithmic signs of degradation—while extending the life of viable assets—leadership can avoid the crippling emergency failure premium. Paired with performance monitoring and efficiency mechanisms that harvest utility savings for capital reinvestment, leadership can align infrastructure stewardship directly with institutional strategic plans and decisively bend the deferred maintenance curve.

Introduction

For decades, deferred maintenance has reached the Board of Trustees as a single figure: a backlog total, refreshed annually, explained by capital scarcity, and set aside until the next failure forced the conversation open again. The number grew, the buildings aged, and the institution's options quietly narrowed.

That era is decisively over.

Gordian's 13th edition of *The State of Facilities in Higher Education* (April 2026) places the capital renewal backlog at \$156 per gross square foot—up 8 percent in a single year and nearly double its 2007 level. Institutions fund only 73.5 percent of what is required to keep the backlog from growing, and operating budgets sit 18.5 percent below target [2]. Moody's has estimated a nearly \$1 trillion “hidden liability” in physical capital needs over the next decade across the roughly 500 institutions it rates [3]. At the system level, Kansas's six public universities saw their maintenance needs climb from \$1.2 billion in fiscal 2020 to \$1.66 billion, even as annual maintenance spending nearly doubled [5].

The Smart Campus Manifesto names the underlying condition directly. **Deferred maintenance is not a static number referring to “old buildings”; it is an escalating problem that builds up financially, operationally, and environmentally, and slowly erodes institutions' strategic options** [1, p. 75].

***A backlog funded at 73.5 percent of need is not being managed—
It is being scheduled to grow.***

This briefing translates the Manifesto's principles into eight leadership actions, each grounded in institutions that have put them into practice. The actions are ordered by depth and scope of impact: from the governance and funding decisions that change the rules generating the backlog, to the portfolio and procurement choices that remove or prevent liability, to the operational intelligence that slows its growth one asset at a time. Before the actions, a section on vocabulary, measurement standards, and benchmarks establishes what is being counted and what “average” means, with reported backlogs from institutions across the country. After them, a summary of modern OT and Operational AI capabilities shows how technology changes the management of both today's and tomorrow's backlog. A summary chart closes the briefing.

The Mathematics of the Curve

The backlog obeys simple arithmetic. Every year, the campus portfolio consumes a portion of its useful life. When renewal investment falls below that rate of decay, the backlog grows—no matter how capable, dedicated, or efficient the facilities organization may be. Three forces then accelerate the curve:

- **Nonlinear Degradation**
Aging assets degrade nonlinearly, concentrating cost, emissions, and failure into short windows that destabilize budgets, operations, and trust [1, p. 102].
- **The Emergency Premium**
Unforeseen failures cost significantly more than scheduled renewals and displace preventive maintenance, creating a cycle in which neglect today causes crises tomorrow [1, p. 75].
- **The Carbon Penalty**
Worn envelopes and drifting controls silently raise energy consumption. The backlog therefore appears twice—once on the capital ledger and again on the utility bill [1, Ch. 6].

Every action that follows works on one of three levers: raising the rate of renewal investment, reducing the square footage that must be renewed, or extracting more life from every dollar already in the ground. Leaders who flatten the curve pull all three at once.

Naming and Measuring the Backlog

Before a backlog can be governed, it must be named and measured consistently. Here the field is less settled than its importance suggests. The same physical reality—work that should have been done and was not—appears under a half-dozen labels, is counted over different time horizons, and is divided by different denominators. Two institutions reporting “\$1 billion in deferred maintenance” may be describing very different things.

*A backlog without a definition
is not a metric—it is a headline.*

The Vocabulary of Deferral

The terms below are the ones leaders most often encounter in assessments, budget requests, and peer comparisons. The distinctions matter most when a figure is used to compare institutions or to argue for funding.

Table 1. Common terms for deferred maintenance and what they usually count

Term	What It Usually Counts	Where Leaders Encounter It
Deferred maintenance (DM)	Maintenance and repair “not performed when [it] should have been,” carried forward to a future period [21][22]. Strictly, work already past due.	Facility condition assessments; Board and legislative reports
Deferred maintenance and repairs (DM&R)	The federal accounting term. FASAB SFFAS 42 requires entities to describe M&R policies, define acceptable condition standards, and report DM&R balances by asset category [21].	Federal agencies, national laboratories, federally reported research facilities
Capital renewal / deferred capital renewal	Replacement of major building systems (roofs, envelopes, MEP) as they reach end of life; “deferred capital renewal” is renewal that came due and went unfunded [2][3].	Gordian benchmarking; capital plans
Renewal need or backlog (multi-year)	Past-due work <i>plus</i> systems forecast to fail within a planning horizon, often 10 years. Penn State’s \$1.72 billion (2021) combined \$330 million one-time, \$530 million past expected life, and \$860 million due within 10 years [29].	System capital plans (e.g., UMass “10-year backlog”) [32]
State program terms	Funding categories for preserving existing buildings: Georgia’s Major Repair and Rehabilitation (MRR) , Minnesota’s Higher Education Asset Preservation and Replacement (HEAPR), North Carolina’s Repairs and Renovations [16][31].	State capital budgets and appropriations
Modernization / functional renewal	Work to meet new codes, accessibility, programs, or research standards. Frequently excluded from DM totals even when it is the costlier need.	Master plans; renovation business cases
Embodied debt obligation	Gordian’s framing of accumulated underinvestment as a liability carried by the institution [3].	Board and rating-agency narratives
Technical debt	The Manifesto’s digital analog: “the digital form of deferred maintenance”—a deliberate delay that accrues “interest” as complexity and risk [1, p. 30]. In OT, it includes unsupported controllers and legacy building automation.	IT/OT governance; cybersecurity risk registers

Standards and Measures

No single standard governs how a university must measure its backlog. Instead, practice rests on a family of methods, ratios, and accounting rules that institutions combine:

- **Facility Condition Index (FCI)**

The most widely used ratio: deficiency (deferred maintenance) cost divided by current replacement value (CRV). The bands most often quoted come from NACUBO's *Managing the Facilities Portfolio* (1991): Good below 0.05, Fair 0.05–0.10, Poor above 0.10. Many institutions now set their own targets [24]. APPA uses the FCI in its Strategic Assessment Model and Facilities Performance Indicators [24].

- **Facility Condition Assessment (FCA) Methods**

ASTM E2018 (Property Condition Assessments) provides a baseline assessment process; ASTM UNIFORMAT II classifies building elements; and RSMeans cost data prices deficiencies. The University of Central Florida's FCA procedure, for example, cites all three and reinspects facilities generally every two years [25][26].

- **Federal Accounting: FASAB SFFAS 40 and 42**

Define deferred maintenance and repairs and require federal entities to disclose policies, condition standards, and DM&R balances by asset category, effective for periods beginning after September 30, 2014 [21].

- **Governmental Accounting: GASB Statement 34**

The “modified approach” for eligible infrastructure requires an asset inventory, condition assessments, and comparison of estimated with actual preservation spending. A 2026 GASB exposure draft would extend that comparison from five to ten periods, with a proposed effective date for fiscal years beginning after June 15, 2028 [27].

- **Asset Management Frameworks: ISO 55000 Series**

The international standard for managing physical assets across their lifecycle, providing the governance scaffolding—policy, objectives, risk, and performance evaluation—into which condition data and FCI targets fit [37].

- **Reinvestment Benchmarks**

The National Research Council's *Budgeting for Facilities Maintenance and Repair Activities* (1996) set out a 2 to 4 percent of CRV guideline for maintenance and repair budgets [23]. Penn State has cited an industry standard of 2 to 2.5 percent against its own 1.65 percent [29], and APPA instruction uses a 2.5 percent rule of thumb [28].

APPA instruction offers an essential caution: the FCI “may be an indicator of risk” but is “not an indicator of operational capability” [28]. A building can carry a high FCI and still function, and a low-FCI building can fail tomorrow if a single critical system is neglected. This is precisely the gap that continuous operational data is positioned to close.

What Is “Average”?

There is no openly published national average FCI for higher education; most benchmark datasets (Gordian, APPA's Facilities Performance Indicators) are available to participants rather than the public. The most widely cited open benchmark is Gordian's: **\$156 of deferred capital renewal per gross square foot** as reported in its 2026 report, with institutions funding **73.5 percent** of the reinvestment needed to hold the backlog steady [2].

Read against the NACUBO bands, an FCI above 0.10 has long been regarded as “poor.” Yet the public systems that report both a backlog and their square footage fall in a range of roughly **\$140 to \$200 per square foot**—at or above the Gordian figure (Table 2). For leaders, the practical definition of “average” is therefore

sobering: the typical campus is not holding its condition steady. It is losing ground by about one-quarter of its required reinvestment each year.

***“Average” does not mean stable.
It means slowly declining.***

Table 2. Reported deferred maintenance backlogs at selected institutions and systems

Institution / System	Reported Backlog	What Is Counted	Scale and Context	Src.
National benchmark (Gordian database)	\$156 / GSF (2025)	Deferred capital renewal	Up 8% in one year; 73.5% of needed reinvestment funded	[2]
University of California (10 campuses)	\$9.1B (2023–24)	Deferred maintenance	63M sq ft; ≈\$144/sq ft*	[30]
California State University (23 campuses)	\$8.3B (2023–24)	Deferred maintenance; projected to grow ~\$397M/yr	43M sq ft; ≈\$193/sq ft*	[30]
UNC System	\$6.4B (2021)	Cost to bring all buildings to an acceptable standard (FCA)	System-wide assessment	[33]
University of Minnesota	\$6B (2026)	Repair backlog; \$100M HEAPR request is the minimum to keep it from growing	30M sq ft; ≈\$200/sq ft*; 8.8M sq ft poor or critical	[31]
University of Massachusetts System	\$4.8B (FY24)	10-year backlog (Gordian)	27.6M GSF; CRV ≈\$17.5B; need ≈0.27 of CRV*	[32]
Penn State University	\$1.72B (2021)	One-time needs + past-life components + 10-year renewals	Reinvesting 1.65% of replacement value vs. 2–2.5% standard	[29]
Kansas Regents (6 universities)	\$1.66B (2026 report)	Deferred maintenance	Up from \$1.2B in FY2020; system graded “C”	[5]
Cal Poly Pomona	\$890M (2026)	Deferred maintenance	About one-third of buildings at least 60 years old	[34]
University of Missouri (Columbia)	\$881M (2022)	E&G deferred maintenance	Maintenance budget ≈0.52% of CRV	[6]
University of Houston	\$708M (2024)	Deferred and planned maintenance	Up 35% from \$524M in 2020	[35]
Houston City College	\$107M (2026)	Maintenance needs (facilities report)	Community college district	[36]

*Calculated for this briefing by dividing the reported backlog by reported square footage or current replacement value. Because institutions count different scopes and horizons (Table 1), cross-institution comparisons are indicative only. Figures are as reported by the cited source on the date shown.

Eight Actions to Flatten the Curve

1. Govern Deferral as Compound Risk

The first action costs almost nothing and changes everything. The Manifesto **reclassifies deferred maintenance from “an unfortunate but manageable byproduct of capital scarcity” to compound risk, and it places a choice squarely before leadership: whether deferral is “a deliberate, time-bound strategy with known risk, or an unconscious transfer of liability to future administrations”** [1, p. 102].

Governance makes that choice visible. When every deferral carries an owner, an expiry date, and a quantified cost of waiting, deferral stops being a passive default. It becomes an active decision that must be defended openly.

The Strategic Response

- **Deferral Risk Registers**

Record each deferred critical asset in the enterprise risk register with an accountable owner, a review date, and a modeled cost of further delay.

- **Board-Level Condition Targets**

Adopt a portfolio condition target—a facilities condition index (FCI) ceiling or a condition grade—and report progress against it to the Board every year.

General Industry Benchmarks of FCI:

- 0% – 5%: Excellent condition (well-maintained, minimal repairs needed)
- 5% – 10%: Good condition (minor or routine maintenance required)
- 10% – 30%: Fair condition (significant deferred maintenance accumulating)
- 30% or higher: Poor / Needs Attention (high capital risk, frequent component breakdowns)
- 60% or higher: Critical condition (replacement is often more cost-effective and justified than repairing [38])

- **Renewal Before Expansion**

Require that renewal needs be addressed, or explicitly accepted as risk, before new square footage is approved.

The Trap

Approaching the Board with a spreadsheet showing a \$200 million deferred maintenance backlog and asking for a massive budget increase simply because assets have exceeded their expected lifespan [1, p. 92].

The Translation

“We are not asking you to pay for the past. We are asking you to decide, explicitly, which risks this institution will carry, for how long, and at what price. Every deferral on this list now has an owner, an expiry date, and a modeled cost of waiting. Here is what each one will cost us if we wait another year.”

Referenceable Examples

- **Kansas Board of Regents**

The Regents grade the condition of the six-university system each year. The system holds a “C,” and leadership has quantified that reaching its “B+” target would cost more than \$1 billion—converting an abstract backlog into an explicit, governable gap [5].

- **State of Utah**

Utah statute has required that capital improvements to existing state buildings be funded before any new capital development project can be approved, placing renewal ahead of expansion in the budget sequence [15].

- **Risk and Insurance Practice**

HUB International recommends an annual facilities dashboard for trustees and warns that repeated maintenance-driven claims can bring water-damage exclusions, higher premiums, and questions about future insurability [18].

2. *Unify Capital Authority and Fund Renewal at the Rate of Decay*

No amount of analytical precision can overcome a structural funding gap. If a campus reinvests at less than the rate its assets wear out, the backlog grows by design. The Manifesto identifies the Executive Vice President of Administration / COO—or, depending on the organization, the CFAO—as the natural executive sponsor precisely because this leader holds unified capital authority: the authority “to merge the IT capital budget with the Facilities deferred maintenance budget” and to defend an integrated 30-year Total Cost of Ownership model before the Board of Trustees [1, p. 146].

Unified authority matters because the smart campus erases the old boundary between the digital and the physical. A building automation upgrade is simultaneously an IT project, a facilities renewal, a cybersecurity control, and an energy investment. Funded from separate silos, it is too often funded by none.

The Strategic Response

- **Renewal Funding Floor**
Establish a recurring renewal allocation indexed to current replacement value (CRV), and publish each year the floor is not met.
- **A Single Cyber-Physical Capital Plan**
Combine IT/OT infrastructure and facilities renewal into one capital plan with one prioritization method and one 30-year TCO model.
- **Leverage, Not Substitution**
Structure central or state renewal funds as matching dollars so that they draw institutional investment in rather than replace it.

Referenceable Examples

- **State of Utah**
In 2001 the Legislature raised the statutory minimum for capital improvements from 0.9 to 1.1 percent of the replacement value of all state buildings—an explicit renewal floor indexed to CRV. Later amendments permitted funding below that level during revenue shortfalls, a reminder that floors must be defended to endure [15].
- **Kansas Regents Universities**
The state provides upwards of \$60 million a year for university building maintenance, which universities must match except when the funds are used for demolition. University maintenance spending rose from \$107 million in FY2023 to \$203.2 million in FY2025 [5].
- **University System of Georgia**
The Major Repair and Rehabilitation (MRR) program funds critical building systems and infrastructure across the system’s state-funded space, with \$65.9 million in the FY2026 base budget [16]; the Governor’s January 2026 budget recommendations proposed an additional \$40 million [17].
- **A Cautionary Benchmark**
Before launching its space reduction program, the University of Missouri’s maintenance budget was roughly 0.52 percent of CRV—well below industry standards, which are three to six times higher [6].

3. Right-Size the Portfolio

The fastest way to eliminate deferred maintenance is to eliminate the building that carries it. Demolition, consolidation, and divestment are the only actions that remove liability permanently rather than postpone it. The Manifesto’s call for Dynamic Spatial Intelligence—anonymized Wi-Fi telemetry, occupancy sensing, and spatial analytics—exists to make these decisions defensible, allowing the institution to “consolidate operations, redesign underutilized spaces, and potentially divest from unnecessary real estate” [1, Ch. 5], and “identifying underutilized real estate to save millions in deferred maintenance or new construction” [1, p. 32].

Every square foot retired never again needs to be renewed, heated, cooled, secured, or insured.

The Strategic Response

- **Condition-Plus-Utilization Screening**
Pair facility condition scores with measured utilization to identify buildings that are both expensive to keep and lightly used.
- **Mandatory Space Surveys**
Use annual space-use data to locate the capacity that can absorb functions displaced by consolidation.
- **Demolition as Investment**
Treat demolition funding as capital with a calculable return on avoided renewal, operations, and energy costs.

Referenceable Examples

- **Kansas Regents Universities**
Since FY2023, Kansas universities have demolished 29 buildings totaling 742,000 square feet, eliminating about \$123 million in maintenance needs, with additional candidates expected to remove at least \$250 million more [5]. An early \$16.5 million allocation to raze 20 buildings was projected to erase about \$80 million in deferred obligations [4].
- **University of Missouri**
Set a goal of eliminating one million gross square feet. Buildings with a Facility Condition Needs Index of 0.40 or higher became candidates for demolition or divestment. The plan targeted a reduction of more than \$200 million in an \$881 million E&G backlog and roughly \$9 million in annual operating savings [6].
- **Penn State University**
A 2025 recommendation to close seven Commonwealth Campuses cited more than \$200 million in future facilities investment that would otherwise be required to keep them open [7].
- **National Context**
Gordian characterizes the slowest growth in campus construction in roughly 40 years as healthy “right-sizing” ahead of a projected enrollment decline. A report from the Western Interstate Commission for Higher Education indicates that the number of high school graduates will peak at 3.8 to 3.9 million in 2025 and then gradually decline, resulting in about 13% fewer graduates by 2041. However, the gains or losses are regional. The South is the only region projected to see an increase in high school graduates (+3%). The largest decrease is projected for the West, with a 20% decline, followed by the Northeast (-17%) and the Midwest (-16%). [3]

4. Stop Manufacturing New Backlog

Every new building is a future backlog. The Manifesto treats procurement as “a strategic control surface” and insists that capital projects be evaluated on total lifecycle value, not lowest first cost [1, pp. 102, 118]. When asset data continuity is enforced from design through operations, “deferred maintenance is no longer an unknowable future liability but a measurable outcome of procurement and design decisions” [1, p. 119].

The CFaO's strategic synthesis is unambiguous: every capital project, every equipment replacement, and every vendor contract must support ingesting operational data into a central Digital Twin [1, Ch. 5]. An asset that arrives without data arrives already partly deferred.

*A facilities asset that arrives without data
arrives already partly deferred.*

The Strategic Response

- **Lifecycle-Cost Selection**
Evaluate designs and equipment on 30–50 year total cost of ownership, including maintainability, energy, and end-of-life value.
- **Digital Handover**
Require BIM and COBie asset data—serial numbers, warranties, installation dates—at turnover, so every asset enters the CMMS and the Digital Twin on day one.
- **Open Systems by Contract**
Require open protocols and data access in every controls contract to prevent proprietary lock-in that shortens useful life and inflates replacement cost.
- **Fund the Tail**
Approve new square footage only with an identified, recurring renewal stream attached.

Referenceable Examples

- **University of Northern Iowa**
Its BIM standards require the constructor to update COBie data as equipment is installed and deliver it to the owner at occupancy, including warranty terms, serial numbers, installation dates, and tag numbers [19].
- **State of Utah**
The renewal-before-expansion rule described above functions as a procurement guardrail at the state level: new square footage competes only after existing assets are funded [15].

5. Unlock and Recycle Capital

When the operating budget cannot carry renewal, leaders must look to the balance sheet—and to the savings their own buildings can produce. The Manifesto’s flywheel is explicit: the gains it generates “are not extracted; they are reinvested” in deeper modernization [1, p. 116]. Three mechanisms convert that principle into capital:

- **Energy Savings Performance Contracts (ESPCs)**
A partner finances and delivers infrastructure renewal that is repaid from guaranteed energy and operational savings.
- **Green Revolving Funds**
An internal fund lends to efficiency and renewal projects; the resulting savings repay the fund, which then lends again.
- **Utility Public-Private Partnerships (P3s)**
A concessionaire pays an upfront sum to operate the utility system and assumes responsibility for its operation and renewal over a long term.

Referenceable Examples

- **University of Illinois Chicago**
A roughly \$30 million ESPC with Ameresco was structured to address deferred maintenance at no

immediate cost, with expected savings of about \$1 million per year, following an earlier \$65 million ESPC with the same partner [10].

- **Green Revolving Funds**

A Sustainable Endowments Institute survey of 52 campus funds found a median annual return on investment of 32 percent; Stanford's Energy Retrofit Program averaged a four-year simple payback [11]. Harvard's Green Loan Fund is among the earliest models [20].

- **The Ohio State University**

In 2017, Ohio State leased its utility system to an ENGIE–Axiom consortium for 50 years in exchange for \$1.015 billion upfront plus \$150 million in academic collaboration support [8].

- **University of Iowa**

In 2019, Iowa entered a 50-year agreement with ENGIE and Meridiam for \$1.165 billion upfront, placing most of the proceeds in an endowment projected to yield \$15 million a year, while paying an annual fee of \$35 million in years one through five that escalates 1.5 percent annually thereafter [9].

A Note of Caution

P3S are not free money. They exchange an upfront payment for decades of fees and reduced operational control. The Manifesto's warning about opaque vendor dependencies applies with full force: performance obligations, data access, maintenance standards, and cybersecurity requirements must persist throughout the agreement's term, well beyond commissioning [1, p. 119].

6. Build the Evidence Base

An institution cannot govern what it cannot see. The Manifesto asks leaders to replace budget-cycle thinking with lifecycle questions [1, Ch. 6]:

- What is the total cost of ownership over 30–50 years, not five?
- How does deferred maintenance amplify risk and carbon simultaneously?
- Where does replacing a component destroy embedded value?
- What assets should be extended versus retired?

Answering them requires a trusted, current picture of portfolio condition. The Manifesto cautions that replacing components too early “wastes embedded value” just as surely as waiting too long creates crises; a disciplined campus distinguishes assets suitable for extension, stabilization, or retrofitting from those that truly need retirement [1, Ch. 6].

The Strategic Response

- **Cyclical Condition Assessments**

Have qualified professionals assess every building at least every five years, and quantify the backlog with cost estimates [18].

- **Prioritize by Consequence**

Rank needs by health and safety first, then building condition, operational impact, and asset age [18].

- **Four Lifecycle Paths**

Classify each major asset as extend, stabilize, retrofit, or retire, rather than replacing on age alone [1, Ch. 6].

- **A 10–30 Year Capital Plan**

Use lifecycle cost modeling to time replacements and benchmark against peers [2][18].

Referenceable Examples

- **University of Missouri**
Used a published Facility Condition Needs Index threshold (0.40) to move portfolio decisions from debate to criteria [6].
- **Kansas Board of Regents**
An annual, system-wide condition grade makes year-over-year progress—or slippage—visible to legislators and the public [5].
- **Gordian**
Recommends data-driven benchmarking and proactive maintenance as the basis for strategic reinvestment [2].

7. Triage with Predictive Intelligence

The Manifesto calls for an aggressive pivot from “run-to-failure” and age-based replacement toward AI-driven predictive asset management, “directing scarce capital only toward systems that exhibit quantifiable, algorithmic signs of imminent failure” [1, p. 84]. In the CFaO’s board narrative, vibration and acoustic telemetry “will tell us exactly which assets have another 5 years of life left and which are failing today” [1, p. 93].

Predictive intelligence does not shrink the backlog’s dollar value on its own. It changes which dollars are spent first, extends the life of assets that still have life to give, and avoids the emergency premium. Its precondition is equally clear: sensors added to a failing system produce data that “cannot be fully trusted, expanded, or protected” [1, p. 75].

*Sensors do not pour concrete—
They tell you where to pour it.*

The Strategic Response

- **Start with Consequence**
Instrument high-value, high-consequence assets first: chillers, boilers, air handlers, and laboratory exhaust systems.
- **Stabilize Before You Instrument**
Recommission controls and correct drifted sequences before layering analytics on top of them.
- **Close the Loop**
Route fault detection and diagnostics (FDD) findings into the CMMS as predictive work orders carrying an estimated cost of inaction.

Referenceable Examples

- **University of Iowa**
Onboarded 20 buildings (2.685 million square feet) to FDD in about three months, realized roughly \$600,000 in energy savings in the first six months, generated 253 predictive work orders, and raised predictive work to 24 percent of all work orders against a 25 percent goal [12].
- **Yale University**
Has used automated fault detection and diagnostics since 2019 across more than 650 air handling units, saving \$580,000 and 17,700 MMBtu in FY2022. The software estimates the cost of leaving

each fault unrepaired to guide priorities, and year-long diagnostic commissioning at the Schwarzman Center found twice as many issues as conventional methods [13].

- **University of California, Irvine**

Its Smart Labs Initiative achieved 60 percent energy savings in laboratories through dynamic, intelligent HVAC controls, as documented by the U.S. Department of Energy [14].

8. Redeploy Workforce Capacity

The backlog is also a labor problem. As the “Silver Tsunami” of retirements carries away years of undocumented, intuitive knowledge about each campus’s quirks, institutions lose the very expertise needed to keep aging assets alive [1, Ch. 4]. The Manifesto proposes that automating roughly 30 percent of a technician’s time spent on manual inspections and travel saves hundreds of hours that can be “redirected toward addressing deferred maintenance and strategic infrastructure upgrades” [1, p. 250].

The Strategic Response

- **Reclaim and Reassign Hours**

Replace route-based inspections with remote monitoring, and assign the recovered hours explicitly to backlog work rather than letting them disappear into reactive demand.

- **Capture Tacit Knowledge**

Encode retiring operators’ experience in Digital Twins and AI knowledge bases before it walks out the door [1, Ch. 4].

- **Measure the Shift**

Track the ratio of planned and predictive work orders to reactive work orders as a leading indicator of backlog growth.

Referenceable Examples

- **University of Iowa**

Set a target of 25 percent predictive work orders and reached 24 percent within months of deploying FDD [12].

- **University of Missouri**

Cited the need to move from reactive to preventive maintenance as a core reason for its space reduction program [6].

Stop Driving in the Rear View Mirror- Modern OT and Operational AI Change the Perception of Backlog

Traditional backlog management runs on a slow clock. A facility condition assessment (FCA) is performed every two to five years, priced, entered into a capital plan, and then ages in place while the buildings it describes keep changing. Between assessments, leaders govern from a photograph of a moving object.

Modern Operational Technology and Operational AI replace that photograph with a live feed. The Manifesto distinguishes Operational AI from Generative AI: where Generative AI improves productivity for knowledge workers, Operational AI “interacts with chillers, predicts equipment failures, and autonomously adjusts HVAC systems,” evolving “from a suggestion dashboard to a trusted autonomous partner in building management” [1, p. 81]. Its Operational AI agents go further, assembling for every emerging risk the “probable root cause, confidence level, recommended intervention window, required parts, safety constraints, and estimated impact if deferred” [1, p. 59].

These capabilities act on the backlog across two horizons: today's backlog, which must be triaged, extended, and sequenced, and tomorrow's backlog, which can be prevented from accruing.

Table 3. Modern OT and Operational AI capabilities applied to current and future deferred maintenance

Capability	Managing Today's Backlog	Preventing Tomorrow's Backlog	Evidence
OT telemetry and sensor grids (vibration, acoustic, temperature, metering)	Reveals true condition between assessments; separates assets with years of life left from those failing now [1, p. 93].	Establishes baselines so degradation is detected early, before it becomes a deficiency.	Manifesto Ch. 4–5
Fault detection and diagnostics (FDD/AFDD)	Ranks faults by estimated cost of inaction; recovers energy waste that can fund repairs.	Continuous commissioning stops drift-driven wear in new and existing buildings.	Iowa: ~\$600K in 6 months [12]; Yale: \$580K in FY22 [13]
Operational AI agents	Turn alerts into decision-ready, prioritized work orders that include “estimated impact if deferred” [1, p. 59].	Institutionalize operational memory, replacing “tribal knowledge” as experienced staff retire [1, p. 60].	Iowa: 253 predictive work orders; 24% predictive share [12]
Digital twin integrated with CMMS/EAM, BIM, and GIS	Creates a “living FCA” whose condition data updates continuously rather than every two to five years.	Models extend, stabilize, retrofit, or retire choices across 30–50 year TCO [1, Ch. 6].	Manifesto Ch. 3, 6
AI lifecycle and capital modeling	Sequences capital by risk, carbon, and mission impact; quantifies “capital debt avoided” for the Board [1, p. 163].	Forecasts renewal waves years ahead, informing a CRV-indexed funding floor.	Gordian benchmarking [2]
Occupancy and spatial intelligence	Identifies underused buildings for consolidation, demolition, or divestment [1, p. 32].	Prevents the construction of space the institution cannot sustain.	Kansas [5]; Missouri [6]
Grid-interactive controls and energy optimization	Generates savings that repay ESPCs and revolving funds earmarked for renewal; reduces runtime on aging equipment.	Condition-aware optimization avoids pushing systems beyond design tolerances, which the Manifesto warns can accelerate degradation [1, Ch. 6].	UC Irvine: 60% lab savings [14]; UIC ESPC [10]
Digital handover and material passports	Documents what is installed, where, and under what warranty.	Ensures assets are not “born deferred”; passports carry performance history and reuse potential for decades [1, p. 104].	UNI COBie standard [19]
Secure IT/OT convergence	Surfaces obsolete, unsupported controllers as a distinct, governed category of backlog.	Prevents cyber-physical technical debt through segmentation, identity, and open standards [1, p. 30; Ch. 5].	Manifesto Ch. 3, 5

Summary

Taken together, modern OT and Operational AI change the backlog in five ways that matter to a President, a CFO, and a Board:

- **From Periodic Estimate to Continuous Measurement**
Condition becomes a live, auditable quantity rather than a figure refreshed every few years, making deferral decisions visible as they are made.
- **From Age-Based to Evidence-Based Capital**
Scarce dollars go to assets showing measurable signs of failure, while assets with remaining life are extended rather than replaced on schedule.
- **From Cost Center to Self-Funding Flywheel**
Energy and operational savings, verified by the same data, become a recurring source of renewal capital.

- **From Tribal Knowledge to Institutional Memory**

Operational AI agents capture and act on the expertise of a retiring workforce, sustaining the technician as “the authority” while “the agent removes friction” [1, p. 60].

- **From Inherited Liability to Prevented Liability**

Digital handover, lifecycle modeling, and secure, open OT architecture stop new backlog from being built into the next generation of buildings.

The limits must be stated with equal clarity. Operational AI reduces uncertainty and waste; it does not by itself close a structural funding gap or retire unneeded square footage. Its greatest value is that it makes the true cost of deferral impossible to ignore—and, in doing so, makes the harder decisions in Actions 1 through 3 easier to justify.

*The facilities condition assessment tells you what the backlog was.
Operational AI tells you what it is becoming.*

Measuring Whether the Curve Is Bending

The Manifesto’s Cyber-Physical Scorecard reframes facilities reporting from decay to yield and risk, including “Capital Debt Avoidance: quantification of deferred maintenance costs avoided through predictive sensor deployments” [1, p. 163]. A backlog program should report, at minimum:

- **Backlog Value and Annual Reduction Rate**

Total deferred maintenance value and its year-over-year change [1].

- **Renewal Funding as a Percentage of Need**

Measured against the level required to hold the backlog steady; Gordian’s national figure is 73.5 percent [2].

- **Square Footage Retired and Liability Eliminated**

Gross square feet removed and the renewal cost permanently avoided.

- **Capital Debt Avoided**

Prevent emergency replacements and extend asset life through predictive intervention [1, p. 163].

- **Predictive-to-Reactive Work Ratio**

The leading indicator of whether the organization is getting ahead of failure.

- **Portfolio Condition**

Facility Condition Index by building and for the portfolio, against a Board-approved target.

*Intelligence bends the curve.
Investment and right-sizing break it.*

Questions for the Cabinet

- Do we know the rate at which our facilities portfolio decays—and are we funding renewal at that rate?
- Which deferrals are deliberate, time-bound decisions, and which are unconscious transfers of liability?
- Which buildings cost more to keep than the mission value they deliver?
- Does every new capital project arrive with its asset data and a funded renewal stream?
- Are energy savings recycled into renewal, or absorbed by the general budget?
- Who holds the authority to fund a cyber-physical upgrade that is part IT, part facilities?

Summary of Recommendations

Figure 1. Leadership actions ordered by depth and scope of impact on the deferred maintenance curve

#	Action	Depth of Impact	Scope of Impact	Primary Owner	Time to Impact	Referenceable Evidence
1	Govern Deferral as Compound Risk <i>Deferral registers, Board condition targets, renewal before expansion</i>	●●●●● <i>Structural</i>	Enterprise: Board, Cabinet, every asset class	Board; President; EVP/COO	6–12 months to establish; compounds thereafter	Kansas Regents annual condition grade (“C”; >\$1B to reach “B+”) [5]; Utah renewal-before-expansion statute [15]; HUB trustee dashboard [18]
2	Unify Capital Authority and Fund Renewal at the Rate of Decay <i>CRV-indexed floor; single cyber-physical capital plan</i>	●●●●● <i>Structural</i>	Enterprise: all capital and IT/OT budgets	EVP/COO; CFO; state system	1–3 budget cycles	Utah 1.1% of replacement value floor [15]; Kansas ~\$60M/yr matched, \$203.2M spent FY25 [5]; USG MRR \$65.9M FY26 + \$40M proposed [16][17]
3	Right-Size the Portfolio <i>Consolidate, demolish, divest</i>	●●●●● <i>Permanent elimination</i>	Portfolio: buildings and land	Provost; EVP/COO; CFaO	1–3 years	Kansas: 29 buildings, 742,000 sq ft, ~\$123M needs eliminated [5]; Missouri: 1M gsf target, >\$200M backlog cut [6]; Penn State: >\$200M avoided [7]
4	Stop Manufacturing New Backlog <i>Lifecycle-cost selection, COBie handover, open systems, funded renewal tail</i>	●●●●○ <i>Preventive/structural</i>	Every future asset and contract	CFaO; CTO; Procurement	Immediate for new projects; long-tail payoff	University of Northern Iowa BIM/COBie handover standard [19]; Manifesto procurement as “strategic control surface” [1]
5	Unlock and Recycle Capital <i>ESPCs, green revolving funds, utility P3S</i>	●●●●○ <i>Financial</i>	Central plant, utilities, energy-intensive buildings	CFO; Treasurer; CFaO	12–24 months	UIC ~\$30M ESPC, ~\$1M/yr savings [10]; SEI: 32% median ROI across 52 funds [11]; Ohio State \$1.015B + \$150M [8]; Iowa \$1.165B [9]
6	Build the Evidence Base <i>Cyclical assessments, FCI, 30–50 year TCO, four lifecycle paths</i>	●●●○○ <i>Enabling</i>	Portfolio-wide	CFaO; Capital Planning	6–18 months	Missouri FCNI ≥0.40 demolition threshold [6]; Kansas annual grading [5]; Gordian benchmarking [2]
7	Triage with Predictive Intelligence <i>FDD, vibration/acoustic telemetry, predictive work orders</i>	●●●○○ <i>Systemic</i>	High-consequence building systems	CFaO; CTO	3–12 months	Iowa FDD: ~\$600K in 6 months, 24% predictive work [12]; Yale AFDD: \$580K FY22 across 650+ AHUs [13]; UC Irvine Smart Labs: 60% savings [14]
8	Redeploy Workforce Capacity <i>Reclaimed technician hours, knowledge capture</i>	●●○○○ <i>Operational</i>	Facilities workforce	CFaO; HR	6–18 months	Manifesto: ~30% of inspection/travel time reclaimable [1, p. 250]; Iowa 24% predictive work orders [12]

Reading the chart. *Depth:* **Structural** changes the rules that generate backlog; **Permanent elimination** removes liability outright; **Preventive** and **Financial** stop new liability or unlock capital; **Enabling** and **Systemic** aim existing capital more precisely; **Operational** improves execution. Time to impact is indicative.

Predictive intelligence reliably slows backlog growth, sharpens capital allocation, and pays for itself through energy savings, as Iowa, Yale, and UC Irvine demonstrate. Yet none of the institutions reviewed here closed a structural funding gap with OT or AI alone. The campuses making measurable progress—Kansas and Missouri among them—paired data with two harder decisions: funding renewal at a deliberate rate and retiring square footage the mission no longer needs.

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