	APPA Institute: O&M Track	
	Operations & Maintenance Management Rollie Zumbrunn, Director of Operations	
	University of Virginia Facilities Management rz9t@virginia.edu	
	TESTE TIBETION	
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	Introduction	
	<ul> <li>APPA Institute: Intent and Format</li> <li>O&amp;M, Planning Design &amp; Construction, Energy &amp; Utilities, General</li> </ul>	
	Administration tracks  O&M track: Maintenance, Custodial, Grounds, Special Topics	
	My Background	
2		
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	C '1'	
	Critical Resources	
	APPA's Operational Guidelines for Educational Facilities – Maintenance	
	<ul> <li>National Research Council's The Fourth Dimension in Buildings:</li> <li>Strategies for Minimizing Obsolescence</li> </ul>	
	APPA's Body of Knowledge articles	
_		
3		

#### Maintenance Core Outline

- Why do we invest in maintenance?
- What is it (types, activities) and who is responsible?
- How much of it should we do?
- How do we budget for it and fund?
- · How do we manage it?
- Who should execute it, and how should they be organized?
- · What are tools to check our work?
- What does success look like and how do we get there?
- What special topics and support systems are relevant?

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#### What is the mission of Operations & Maintenance?

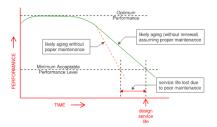
- Within the framework of the institution's mission and character, what are the goals of the facilities management organization?
- FM should seek to provide an optimum physical environment to support institutional missions.
  - Education, Research, Healthcare, Public Service? Entertainment, other?
  - Classrooms, offices, laboratories, infrastructure, housing, performing venues, computing, clinical, vivaria, dining, museums, landscape, historic preservation, etc.
- And promote effective use of resources through leadership, expertise, policies, and decision-making.
  - Life safety, continuity of operations, life cycle costing, alignment of needs and resources, change management, continual improvement.

5



	Chief Facilities Officer Roles and Competencies	
	chief racilities Officer Roles and Competencies	
	• fully knowledgeable of all building systems	
	<ul> <li>advanced degree in architecture/engineering</li> <li>expert in procurement/negotiating procedures</li> </ul>	
	demonstrated skills in leadership and managing organizations	
	• degrees in public relations and computer science	
	Certified Public Accountant	
	demonstrated ability to raise funds     an astute politician	
	• and a law degree	
7		
	What is Maintenance?	
	<ul> <li>Definition: Work required to preserve or restore buildings, systems, and equipment to their original condition or to such condition that they can be effectively used for their intended purpose, ensuring ongoing operation of the</li> </ul>	
	effectively used for their intended purpose, ensuring ongoing operation of the campus. Asset stewardship.	
	Activities include basic services like inspections, servicing, and repairs intended to keep assets in safe operational condition in support of programming.	
	to keep assets in safe operational condition in support of programming.  Reliablity-Centered Maintenance: <a href="mailto:optimize">optimize</a> physical plant availability and quality	
	• Types of maintenance	
	Examples of services     Trades required.	
	<ul> <li>Trades required</li> <li>Needs that <u>are not maintenance</u> – and why Operations must support them.</li> </ul>	
0		
8		
	System Obsolescence & Risk Management	
	Physical Plant as an Institutional resource – where the product is made	
	Maximize availability and utilization, preserve financial and productive value	
	Delay obsolescence due to:     Functional factors	
	Economic factors	
	Technological factors     Social, legal, political, and cultural factors	
	<ul> <li>Failures can be incredibly costly</li> <li>Facility Condition Index (FCI) as a measure of obsolescence and risk</li> </ul>	
	(Deferred Maintenance backlog + Capital Renewal needs) / Current Replacement Value	

# Extension of System Life via Maintenance



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# Expectations for Facilities are Constantly Increasing



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# Risk Evaluation to Align Resources and Expectations

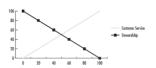
			Severity = (Magnitude - Mitigation)						
Event	Probability	Human Impact	Property Impact	Business Impact	Preparedness	Internal Response	External Response	Risk	
	Likelihood this will occur	Possibility of death or injury	Physical losses and demages	Interruption of services	Proplanning	Time, effectiveness, resources	Community/Mutual Aid staff and supplies	Relative Threat Increases with %	
Score	0 = N/A 1 = Low 2 = Moderate 3 = High	0 = N/A 1 = Low 2 = Moderate 3 = High	0 = N/A 1 = Low 2 = Moderate 3 = High	0 = N/A 1 = Low 2 = Moderate 3 = High	0 = N/A 1 = Low 2 = Moderate 3 = High	0 = N/A 1 = Low 2 = Moderate 3 = High	0 = N/A 1 = Low 2 = Moderate 3 = High	0 - 100%	
Supply Shortage	2	1	1.13	2.25	1.88	1.88	1.75	37%	
Comms Failure	1.88	1.25	0.88	2.5	2	1.5	2	35%	
Electrical Failure	1.88	1.25	1.25	2.38	1.63	1.5	1.38	33%	
Info Sys Failure	1.63	1.38	1	2.63	1.63	1.38	1.38	28%	
Fuel Shortage	1.63	1	0.75	2.13	1.88	1.63	1.88	28%	
HVAC Failure	1.5	1	1	2	2	2	2	26%	
Fire Alarm Fail.	1.14	1.86	1.57	1.71	1.86	1.57	1.86	22%	
Struct, Demage	1	1.22	2.11	1.78	1.78	1.44	1.89	19%	
Sewer Failure	1.13	0.88	1.13	1.63	2	2	1.63	19%	
Transport, Fail.	1.13	1	0.88	1.75	2	1.75	1.63	19%	
Generator Fail.	1.13	1.13	1.38	1.88	1.5	1.38	1.38	18%	
Chill Water Fail.	1.14	1	1.14	1.29	1.71	1.43	2	18%	
Water Failure	1	1.38	1.38	1.88	1.75	1.38	1.5	17%	
Steem Failure	1.13	1	1.13	1.38	1.38	1.13	1.5	18%	
Natural Gas Fail	1	0.88	0.75	1	2.25	1.75	1.5	15%	
Average	1.02	0.86	0.89	1.39	1.36	1.17	1.26	14%	

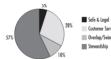
Overlaps and	Interrel:	ationshins	in Types	of Mainten	ance
Overlaps allu	HILEHER	auonsiibs	III IVDES	OI IVIAIIILEII	ance

- Planned and Unplanned
- Reactive and Proactive
- Not Maintenance:
- Support Services
- Capital Plant Renewal



Limited Resources and the tension between Stewardship and Customer Service





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Levels of Maintenance and Benchmarking

- Level 1: Showpiece Facility
- Level 2: Comprehensive Stewardship
- Level 3: Managed Care
- Level 4: Reactive Management
- Level 5: Crisis Response

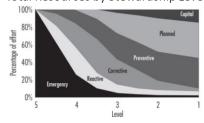
land		1	1	4	5
Description	Slavepince For Rhy	Comprehensive Street-Stilla	Monaged Core	English Ranapower	Crise Regional
Time	Also to emperal to obtainly any type of contract amendments.	Response to ment armine words, including Bestrall superminiments activities, is hypically in a word or less.	Service modelike only by reducing maintaneous, with response feets of one month or less.	Service, analictic only by ordining numberous, with exponent them of one year or less.	Services not posible vides directed have top administration, none possibili except emergencies.
Centerner Sefekschise	Proof of in little, how a high level of that for the leadilies organization.	Satulari with facilities withed needos, usually complementary of building and.	Acceptanced to bear losed of facilities core. Securelly oble to perform existion dation, look of polic in physical environment.	Generally citizal of cart, insparationess, and quality of facilities services.	Consider continue relición, minitad al facilities services.
Presentive Maintenance vs. Corrective Maintenance	005	75-190%	50-735	25-10%	25.
	All materiarded presente expression (ML) is shelded and published on time. Burghe materiards (e.g., spit simpling and objects for character is neintained to the amountable or assured. I mergenian is g., presentating of the control	I will-developed PK program, PM is item of a frequency slightly less than defined trilled in Mark months excensions opened from prevention falses, but plus mobile of lamp formed not. Scottland intemplet to cannot by pump follows, cooling system follows, etc.	offer-note based on exhibit time and takes. The high meriter of ensugencies is g., pump follows, hearing and cooling system followed: cause reports to opport administration.	Liber is used to each to systems that are performing poorly or set at all. Significant free specify possing parts and services due to the high months of arrangement. Me uses smooth of arraphs tracks and observationable (in g., Dier changing, pursing, and has bell aphanometric.	for impact biose, for state aparing, ager- almistration is find of ecoling the operts.
Regulatory Complumes	Right state of all or unknowle serior power for Mr. unknown for signific ductomated (COR), EM, and discussion for signific ductomated (COR), EM, and discussion for signific ductomate (SOR), EM, and discussion for significant for the local hards power for all devices for significant groups of the discuss power and devices compared to the significant consistency and proposed of the significant forming and place. Device proposed proposed proposed communication and unpraised of these steps significant power significant significant consistency many power proposed proposed consistency to the proposed proposed proposed proposed proposed pages on the discussion to the proposed	Ad asserted of OTM, 18%, and the subsy expansion of the children partials from course, a fingly instead of the countree of the spiriture of the countree of th	General neuronal of CSA, CM, and the softy- equipments, relating introduced respective. Alongsite shift have a motive of working personal Alongsite shift have a motive of working personal and personal	Seen examens of DSA, DSA, and the solely encourage, including encourage the hardware dail or contractly assume and to address OSSA, DSA, and the solely insens on they size, Further, and to solely described for contractly to be part of specifically described for the part of DSA, DSA, and DSA solely programs developed with smooth financial.	Life or nonement of 50%, IT, and the shall requirement, including estimated approachables. 2004, 10%, or 20% years represent to except the company in a collected control and produced to the control of the control of the collected and the collected approach to the collected and particular space of the collected and th
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### Levels of Maintenance and Benchmarking

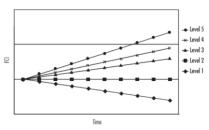
- Needs vary across campus...
- Resource Allocation and Conditions should vary too
  - High profile buildings vs low priority spaces
  - Critical systems: life support; research; healthcare, event venues
  - Seasonality: coordinate maintenance activities with showpiece times, weather impacts, etc
  - Funding: campus "owners" have different ability to pay
  - "Run to failure" strategies ahead of replacement

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# Maintenance Activities as a Proportion of Total Resources by Stewardship Level



# Relative Change to FCI over Time Depending on Maintenance Level



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#### Intensity Factors and Resource Calculation

- Space type
- Campus size
- Campus age and condition
- Building system complexity
- Institutional mission

Figure 3.2		Figure 3.1	
Space Type	Area (gsf)	Staffing Factor	Baseline Staffing
classroom	64,350	15	0.97
laboratory	26,650	27	0.72
office	234,000	24	5.62
residence halls	825,000	18	14.85
compus total:	1,150,000	Total:	22.15

Figure 3.8	Figure 2.6	Figure 2.5	Figure 2.5	Figure 3.9	
RI	Age	Toried Fedities	Size	Compan Mission	Total of Factors
0.06	1.01	0.00	0.90	0.05	0.11
			FEStelling		
	Mono	Stelling reports	(1 + sen of fee	tos) X bessitus st	afing
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#### Preventative Maintenance

- Asset-based (system component)
- Planned, cyclical work to check asset condition and function, provide routine service, replace consumable materials, perform minor repairs
- $\bullet$  Standard work with formalized job plan tailored to specific asset
- Predictive maintenance subtype

	,		

	Maintananaa Funding	
	Maintenance Funding	
	Institutional organization	
	<ul> <li>Consolidated facilities department or decentralized staffing</li> <li>"Auxiliaries" as financially responsible independent operating units</li> </ul>	
	<ul> <li>Responsibility Centered Budgeting</li> <li>Operating unit level differentiation and prioritization</li> </ul>	
	Cost recovery vs central funding     Major events, emergency management, etc	
	Life Cycle Costing (LCC) concept	
	Budgeting methods	
22		
	Integrated Planning Processes	
	Strategic use of resources to meet the goals of the organization     Medium and long-range forecasting	
	Maintenance needs vary throughout the life of a system	
	<ul> <li>Major repairs often need to be coordinated well in advance to minimize impact and procurement times</li> </ul>	
	Resource leveling greatly increases efficiency, particularly for in-house teams     Programmatic approach	
	<ul> <li>Painting, roofs, condition assessments, equipment and vehicles, staffing and training, roads and walkways</li> </ul>	
	Coordination with Capital Renewal Program	
23		
	Dudastina and Dillina Master de	
	Budgeting and Billing Methods	
	Incremental budgeting based on historical costs	
	<ul><li>Formula based budgeting</li><li>\$/GSF</li></ul>	
	Reinvestment Rate: maintenance as a proportion of CRV	
	Zero-based budgeting     "Time & Materials" billing	
	• Fixed price quotes	
	Guaranteed maximum prices     Unit antico (Inh. Order Controller)	
	Unit rates (Job Order Contracting)	

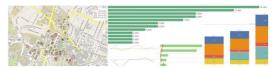
	Maintenance Budget Categories	
25	Stewardship (preventative maintenance) Service work Major repairs Exteriors and grounds Aesthetics and painting	
	Maintenance Management	
	Maintenance Management  The measurement of aspects of maintenance in order to provide the feedback necessary to adjust the overall maintenance plan.  A systematic approach to the upkeep of facilities, grounds, and infrastructure, in support of the institutional mission, applying such management principles as organization, planning, measurement, and control.  Objectives: increase plant utilization, reliability, and cost effectiveness; emphasize service-oriented management principles; enhance condition of the institution; improve communication and decision-making.	
26		
	Maintenance Management Elements  Work order system – to identify and categorize work  Work <u>authorization</u> – to determine availability of resources  When is estimating necessary and when not?  Work <u>control</u> – to plan work, measure success, and document history  Where do work orders come from?  Who decides if, when, and how the work should proceed?  How can historical information be used to guide decision-making?	

	Management tools: CMMS	
	Management tools: CMMS	
	Computerized Maintenance Management System	
	Work requests     Key data elements: requestor, type of work, priority, description	
	Location, system	
	Assignment     Costing and billing (labor, materials, equipment, contractors)	
	Planning and scheduling	
	Communication and feedback     Work order analysis and trending	
	noncolor analysis and deciding	
28		
	Chapter of the OAC and the allower	
	Who does the Work?	
	• <u>In House</u> teams vs <u>Contractor</u> support	
	Zone Maintenance vs Central Shops     Zones: multi-trade teams responsible for general maintenance needs across a specific area of the institution, generally determined geographically. Can increase efficiency, knowledge and ownership of systems, and relationship with building occupants.     Central Shops: centralized trade teams generally responsible for entire	
	campus. Can increase expertise, project capacity, consistency, documentation  • Blended Approach: Zone personnel as "property owners" who rely on	
	specialized central shops, project teams, program managers, and contractors to execute work beyond their capabilities.	
	•	
29		
	Trade Needs	
	nade Needs	
	Institution-dependent: type and resources	
	General trades: service response, event staff, carpentry, paint?	
	<ul> <li>MEP: HVAC, electrical, plumbing</li> <li>Specialty trades: fire alarm, automation services, roofing, locksmith,</li> </ul>	
	masonry, elevators	
	Program support: fleet, roof, paving     Context matters:	
	Do you need to be self-sufficient?	
	Are you big enough to maintain consistent work?	

	Labor Rate Calculation	
	Labor Nate Calculation	
	Billable "wrench time" vs "non-productive" time	
	Fully loaded cost recovery shop rates	
	Total compensation: salaries, leave, benefits     "Other than personnel" costs	
	Supervision and quality control	
	• Overhead	
•	Rate viability and organizational credibility     Some rates may be uncompetitive	
	Some customer requests may be hard to bill	
	But there may still be benefit to providing subsidized services	
31		
-		
	Proving Performance	
•	<ul> <li>Quality control at the shop level</li> <li>Supervision</li> </ul>	
	Contract administration	
<ul> <li>Metrics and Key Performance Indicators (KPIs)</li> </ul>	·	
	• 3 <sup>rd</sup> Party Inspection Teams	
	Long run assessments     Peer benchmarking     Facility Condition Assessments	
	System life cycle analyses     Occupant feedback	
22	•	
32		
	Metrics and Key Performance Indicators	
	,	
	<ul> <li>Pearson's Law: "When performance is measured, performance increases.</li> <li>When performance is measured and reported back, the rate of improvement</li> </ul>	
	accelerates."	
	What matters?     Gaming the system vs material improvements	
	• Examples:	
	<ul> <li>Monthly completion rates, particularly for code-required PM work</li> <li>Response times, particularly for critical requests</li> </ul>	
	Reactive vs Proactive ratio     Building operational data: utility consumption, system uptime	
	Occupant feedback: work orders, complaints     Sensitive work types: pest control, mold, indoor air quality	

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#### INFORMATICS



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#### Facility Assessment Program

- A continuous systematic approach to identifying, assessing, prioritizing, the specific maintenance, repair, renewal, and replacement requirements for all facility assets to provide valid documentation, reporting mechanisms, and budgetary information in a detailed database of facility issues.
- $\bullet$  In house blended inspection team or Consultant Service
- Cyclical assessments to maintain consistency and track changes
- Informed by facility managers, work order data, customers, asset info

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#### Customer Feedback and Surveys

- CMMS as communication tool
- Customer service representatives and Building Coordinators
- Routine meetings to build relationships, share information, align processes, minimize impact, and optimize value
- Engaging building occupants to decrease maintenance expenditures
- Online survey data
- $\bullet$  Who are we working for? "Customer" engagement and support.

QR Code for O&M Maintenance Management I	
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APPA Institute: O&M Wrap Up	
Operations & Maintenance Management Rollie Zumbrunn, Director of Operations	
University of Virginia Facilities Management rz9t@virginia.edu	
38	
Organizational Culture & Resources	
<ul> <li>Support from institutional leaders and management</li> <li>Resources, Trust, Knowledge, Buy-In</li> </ul>	
<ul> <li>Agency and Ownership vs Stewardship?</li> <li>Reactivity and Firefighting – plans get burned down</li> </ul>	
Change Management and Continuous Improvement     "That's how it's always been" is not an explanation	
Command & Control Hierarchy vs Distributed Leadership	
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#### Competing for Resources

- Opportunity Costs: maintenance is not the purpose of the institution!
- Marketing Facilities Management: managing "up and across"
  - LEAN Manufacturing: value is defined by the customer
  - So we need to educate our stakeholders to ensure funding, prioritization
- Budget increase proposals
  - New initiatives and regulatory requirements come with costs
     New programs can entail intensive support needss

  - New buildings often appear "cheap" in short run
  - Business cases for new services

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#### Customer Engagement and Focus

- Predictable processes and services
- Excellent service value and cost control
- Services and programs tailored to their needs
- Strong collaboration and partnership
- Excellent communication
- Expertise and resources
- Responsiveness and resiliency

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#### Marketing Facilities Management



	Related Topics and Support Systems	
	helated Topics and Support Systems	
	<ul> <li>Organizational Values and Initiatives</li> <li>Safety, Sustainability, Training &amp; Development</li> </ul>	
	Facilities Design Guidelines at <u>Institutional</u> Level     Compliance	
	Ioint Commission, Research bodies, Security needs     Fire Marshal and Building Official – processes	
	Fire Marshal and Building Official – processes     Emergency Management	
	<ul> <li>Support Teams</li> <li>IT, Logistics, EHS, Risk Management, Central Monitoring, Fleet</li> </ul>	
	• FM Partners	
40		
43		
	In the stand Section Decima Catalian	
	<u>Institutional</u> Facility Design Guidelines How our buildings are designed and constructed matters!	
	Explicitly Enforce Organizational Values	
	Life Cycle Costing	
	First cost matters but cannot be the only factor     Sustainability & Energy Consumption	
	Safety & Maintainability     Are aesthetics prioritized over serviceability?	
	Efficiency of service	
	<ul> <li>Are assets on rooftop or easily accessible?</li> <li>Are materials and parts readily obtainable?</li> </ul>	
	Are systems standardized throughout the institution?	
44		
	Organizational Values: Safety	
	Foundational competency above all else	
	Risky work is irresponsible – but also expensive     Elimination before mitigation	
	Basic work processes     Job Hazard Assessments for non-routine work	
	High Hazard requirements     Lock Out Tag Out, Confined Space permits, Hot Work permits, Elevated Work	
	Programmatic processes and documentation     Lead, Asbestos	

	Organizational Value: Sustainability	
	Organizational value. Sustainability	
	A Fundamental Component of Stewardship	
	Material disposal     Refrigerants, batteries, oils, lightbulbs	
	Resource conservation     A lastitutional goals for energy waste, and emissions	
	<ul> <li>Institutional goals for energy, waste, and emissions</li> <li>Utility consumption as funding mechanism</li> </ul>	
46		
70		
	Compliance Requirements	
	compliance negativeness	
	<ul> <li>Increasing requirements for documentation of maintenance</li> <li>Regulated activities, materials, and environments</li> </ul>	
	Healthcare, pharmacy	
	Building Automation trend data     Access control systems	
	Research and program requirements     Laboratories, vivaria, museums, performing arts	
	Documentation can often be managed and organized in CMMS to	
	increase accountability and reporting	
47		
	Emergency Management & Risk Management	
	<ul> <li>Facilities Management increasingly expected to engage with institutional leaders to assess and mitigate risks</li> </ul>	
	• FM assets, personnel, and systems critical for response	
	Weather event planning and response	
	All of our work can be thought of in terms of risk management!	
	o. oa. How can be thought of interna of how management:	

#### Operational Partners

- Custodial teams as "first line of maintenance"

  - Eyes in the building
     Potential resource for some work to increase efficiency
  - Customer feedback mechanism
  - Coordination of work
- Systems Control and Work Management
- Fleet
- Document Management and Mapping Services
- Project teams
- Occupant Groups and Leadership

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#### **FM Support Teams**

- Information Technology
- Logistics
- Space Management
- Document Management
- Finance
- Human Resources
- Building Official
- Energy Engineers

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### Operational Data – Quantification & Analysis



# Operational Data – Quantification & Analysis

			Year/Work Type							
			2018 PM	2019 PM	2020 PM	2021 PM	2022 PM	2023 PM	2024 PM	
Maint Zone Level 2	Property	Asset Group	Asset Tag	3 Year Average						
CENTRAL GROUNDS MAINTENANCE ZONE	All	All	All		13,652					18,090
FIN-HOUSING MAINTENANCE	All	All	All		7,331	7,929	7,675	7,520	7,149	7,981
NEWCOMB MAINTENANCE ZONE	All	All	All		5,558	6,387	6,684	7,662	8,837	11,064
IORTH GROUNDS MAINTENANCE ZONE	All	All	All		7,716	8,907	8,670	9,311	9,142	10,518
WW.CORMICK ROAD NAINTENANCE ZONE	All	All	All		10,100	11,125	11,424	11,589	10,840	10,655
IVEST GROUNDS MAINTENANCE ZONE	All	All	All		11,234					13,837

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# Operational Data – Quantification & Analysis



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# Operational Data – Quantification & Analysis



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#### Additional Resources

- Operational Guidelines for Educational Facilities Maintenance (APPA)
- The Facilities Audit: A Process for Improving Facilities Conditions, by Harvey H. Kaiser (APPA)
- Benchmarking & Organizational Change, by Mohammad H Qayoumi (APPA)
- APPA Thought Leaders Series: Transforming Facilities to Achieve Student Success
- The Fourth Dimension in Building: Strategies for Minimizing Obsolescence (NRC Building Research Board)
- Component Renewal Expected Life Guidelines (APPA)
- Other examples and tools (UVA materials available on request):

  - UVA Facility Design Guidelines
     Asset templates and job plans for standardized work
     Metrics and Dashboards
     Emergency Management risk calculation tool

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QR Code for O&M Core Wrap Up

