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ACADEMY

*Preventive & Predictive Maintenance*

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Preventive & Predictive Maintenance  
*How to Achieve Superlative Results Every Day*



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- Certified Property Manager
- Certified Safety Manager
- Certified Safety & Health Compliance Officer
- Master Facility Executive
- National Affordable Housing Professional - Executive
- Certified Financial Manager, Tax Credit Specialist, Senior Housing Specialist and Site-Based Budget Specialist
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**Learning Outcomes**

- Understand Different Types of Maintenance and the Characteristics of Each
- Understanding the Financial Implications of Selected Maintenance Pathways
- Managing the Challenges of an Effective PM and PdM Program
- Ensuring Consistency, Success, and Ongoing Results
- Developing Site-Specific Plans and New Approaches
- Capital Planning and Asset Preservation



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**Introduction**

What you do and how you do it determines the outcome

*"An ounce of prevention is worth a pound of cure."*  
Benjamin Franklin



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**Definition of an Asset**

An asset is something that an entity owns, has use of, and gains benefits from to generate income.

It includes the property itself as well as the various building systems and components also found at our sites.



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**Definition of Functional Obsolescence**

Functional obsolescence is the reduction of the usefulness of a system, component, device or item due to an outdated design or feature that cannot be easily changed, upgraded, modified, or retrofitted to deliver the original product's expectations and no longer meets the user's current operational needs.



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**Definition of Economic Obsolescence**

Economic obsolescence is the reduction in the desirability or economic life of a system or component.

It may be caused by a variety of means including, but not limited to technological advancements, industry, or governmental regulatory changes, or oftentimes excess supply.

In a nutshell, the cost of running the system, using the component or item is costing more than if a new replacement would be if installed.



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**Primary Maintenance Types**

- Routine
- Reactive / Corrective
- Planned
- Run To Failure
- Deferred
- Preventive
- Predictive



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# Routine Maintenance



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## Routine Maintenance

- As a rule, this is the typical maintenance and upkeep that is performed at properties regularly via a series of inspections.
- Routine maintenance is done on an ongoing and scheduled basis.
- This process allows for the ability to identify and prevent problems or other issues before they result in equipment failures.



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## Routine Maintenance

<p><b>Advantages</b></p> <ul style="list-style-type: none"> <li>• Allows for budgeted costs to be utilized in planning</li> <li>• Ensures that equipment is being properly maintained to manufacturer's specifications</li> <li>• Reduces unnecessary downtime</li> <li>• Helps to assure resident satisfaction and best in class customer service</li> </ul>	<p><b>Disadvantages</b></p> <ul style="list-style-type: none"> <li>• Costs money - sometimes more than budgeted/available</li> <li>• Requires planning and scheduling of tasks</li> <li>• Staff may not be trained to perform this work consistently</li> <li>• Replacement of parts sooner than scheduled may limit lifecycle of component and/or system</li> </ul>
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**Routine Maintenance Process**

- Issue a service request in your platform
- Inspect the item, system, component where the work has been requested to be performed
- Gather or order the necessary parts and tools to complete the work
- Determine and assign the priority level to the work order
- Schedule and complete the work
- Close out service request



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**Reactive / Corrective Maintenance**



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**Reactive / Corrective Maintenance**

- This maintenance that is performed when the equipment, system or component has failed. It can also be classified as "emergency" maintenance to get it back in operation as quickly as possible.
- It is an unplanned failure and usually the result of some form of equipment malfunction or worse, unintentional or willful neglect.



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### Reactive / Corrective Maintenance

<p><b>Advantages</b></p> <ul style="list-style-type: none"> <li>• Lower short-term costs - nothing to do after initial installation until it breaks/fails</li> <li>• Minimal planning required - failure has already occurred and now you must react</li> <li>• Simpler processes</li> <li>• Best-case repair scenario in many instances</li> </ul>	<p><b>Disadvantages</b></p> <ul style="list-style-type: none"> <li>• Protocol is unpredictable - you do not know until failure occurs</li> <li>• Increases downtime</li> <li>• Parts and/or equipment may not be readily available</li> <li>• Typically results in increased costs</li> <li>• Efficiencies not being maximized</li> <li>• Reduction to EUL</li> </ul>
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### Reactive / Corrective Maintenance Process

- Issue a service request in your platform
- Observe the performance of the equipment
- Did a breakdown or other unusual activity occur
  - Yes = Perform the required reactive maintenance
  - No = Return to step one and check the equipment
- Close out service request



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### Planned Maintenance



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### Planned Maintenance

- Planned maintenance is a proactive approach to operating maintenance by which maintenance work is scheduled to take place on a regular scheduled basis minimizing risk of premature failure.
- It reduces or even avoids breakdown or emergency maintenance, which always negatively impacts operations and resident satisfaction and customer service.



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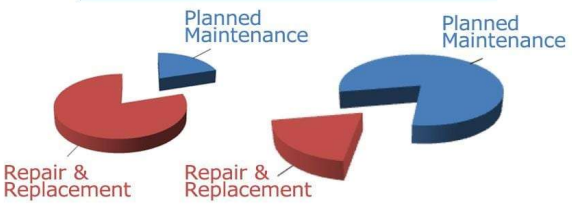

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### Planned maintenance pays big dividends

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### Planned Maintenance

Advantages	Disadvantages
<ul style="list-style-type: none"> <li>• Allows for planned costs</li> <li>• Increases overall operations and assures maximum efficiencies are achieved</li> <li>• Simpler processes - not reactionary</li> <li>• Is always a wise investment of both time and money</li> </ul>	<ul style="list-style-type: none"> <li>• Costs money - sometimes more than available</li> <li>• Requires prescriptive planning and scheduling of tasks</li> <li>• Existing staff may not be trained to perform this work</li> <li>• Labor and cost of parts may cost more in short-term.</li> </ul>



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**Planned Maintenance Process**

- Choose an asset, component, or system to inspect
- Issue a service request in your platform
- Analyze the historical maintenance data that is available
- Determine the best time to perform maintenance
- Run the component, asset or system under normal operating conditions to determine if maintenance is due
- If yes - perform periodic maintenance, if no, return to step one
- Close out service request



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**Run To Failure Maintenance**



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**Run To Failure Maintenance**

- The Run to Failure model is a deliberate "hands-off" asset functionality approach, but you must have a plan for when this happens.
- If an owner or an organization adopts a "run to failure" model, they have made a cognizant decision to perform no ongoing maintenance on that item.
- Equipment or components are installed and then run until a failure occurs - the throw away strategy.
- Planning include who will address failure when it occurs, training of staff, availability of parts.



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### Run To Failure Maintenance Examples

- Smaller motors and pumps
- Baseboard heating units
- VFDs
- Some smaller valves
- FACP
- Exterior fencing
- Metal roofs
- Lighting and fixtures
- Acoustical ceiling tiles
- Sealed insulated glazing units
- CCTV equipment
- Concrete walkways
- Asphalt and bituminous concrete roadways



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### Run To Failure Maintenance

<p><b>Advantages</b></p> <ul style="list-style-type: none"> <li>• Minimal staff required</li> <li>• Minimal oversight</li> <li>• Minimal preparation time</li> </ul>	<p><b>Disadvantages</b></p> <ul style="list-style-type: none"> <li>• Protocol is unpredictable - you will not know until a failure occurs</li> <li>• Inconsistent levels of downtime</li> <li>• Costs associated with downtime and repairs</li> <li>• Inefficient use of overtime labor</li> <li>• Higher vendor and contractor costs</li> <li>• Resident dissatisfaction</li> </ul>
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### Run To Failure Process

- A new part, component, system is installed
- The part, component or system runs and functions as expected during its service life
- A failure occurs
- Issue a service request in your platform
- Replace the part, component, or system
- Close out service request



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# Deferred Maintenance



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## Deferred Maintenance

- Deferred maintenance is the postponing of a building's or a property's upkeep of its equipment from an entity's normal operating budget cycle due to a lack of funds.
- This lack of funding for routine maintenance can cause serious neglect, allowing what otherwise would be classified as capital repair work to evolve into more serious conditions. The problem is further compounded by choices made during lean financial times when routine maintenance is often deferred in order to meet other fiscal requirements.
- The failure to take care of major repairs and/or restore building's components that have reached the end of their useful lives results in a deferred maintenance backlog.



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## Deferred Maintenance

<p><b>Advantages</b></p> <ul style="list-style-type: none"> <li>• None!</li> </ul>	<p><b>Disadvantages</b></p> <ul style="list-style-type: none"> <li>• Could result in severe physical asset degradation</li> <li>• Decreases the site's total value</li> <li>• May result in life-safety issues which could result in lawsuits or insurance claims</li> <li>• Higher vendor and contractor costs due to increased scope</li> <li>• Resident dissatisfaction</li> </ul>
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### Deferred Maintenance Process

- An item, component, system is determined to be in need of either repair or replacement
- A service request is generated in your platform
- An analysis takes place to determine if enough resources are available
  - Yes = Schedule the maintenance
  - No = Add to backlog
- Once the work has finally been performed, close out service request



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### Preventive Maintenance



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### Preventive Maintenance

- Preventive maintenance (PM) is best defined as the servicing, care and upkeep by trained maintenance professionals, whether in-house staff or contractors in maintaining a property's facilities, equipment, systems and components in satisfactory operating conditions.
- This is achieved by performing systematic inspections, tests, adjustments, measurements and verification as well as other diagnostics to prevent faults and unnecessary equipment failures.
- This plan should never be considered "all inclusive" as systems, components, protocols, and technology is ever-changing.
- Not having a plan costs more than a plan itself.



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### Preventive Maintenance

Preventive maintenance programs offer numerous important benefits including:

- ✓ Prolonged life of equipment
- ✓ Less unplanned downtime caused by equipment failure
- ✓ Less unnecessary maintenance and inspections
- ✓ Fewer errors in day-to-day operations
- ✓ Improved reliability of equipment
- ✓ Fewer expensive repairs caused by unexpected equipment failure that must be fixed quickly
- ✓ Reduced risks of injury



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### Maintenance Task Intervals

- ✓ Daily
- ✓ Weekly
- ✓ Monthly
- ✓ Quarterly
- ✓ Semi-Annually
- ✓ Annually
- ✓ Five-Year



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### Preventive Maintenance

<p><b>Advantages</b></p> <ul style="list-style-type: none"> <li>• Increased Operating Life Expectancy</li> <li>• Cost-Effective</li> <li>• Saves Energy and Resources</li> <li>• Reduces Unplanned Downtime</li> <li>• Contributes to Improved Staff Productivity</li> <li>• Ensures Resident Satisfaction</li> </ul>	<p><b>Disadvantages</b></p> <ul style="list-style-type: none"> <li>• Time that is required to plan and schedule tasks</li> <li>• Does not consider functionality or wear causing excessive maintenance</li> <li>• While PM can reduce risk of various types of catastrophic failures, it cannot be totally eliminated.</li> </ul>
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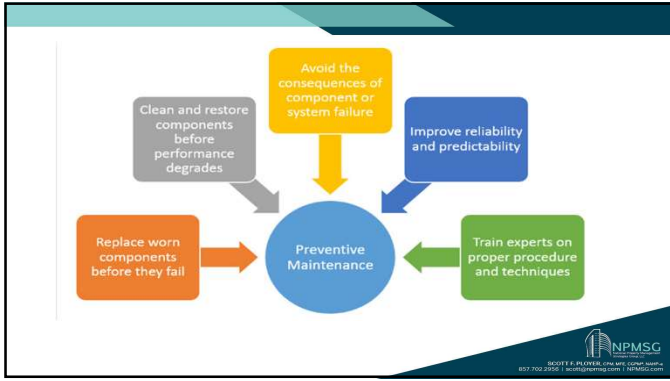
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The New World Order  
Predictive Maintenance

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### Predictive Maintenance

- With predictive maintenance (PdM), maintenance is performed at manufacturers (OEM) requirements just before the equipment fails using a variety of predictive indicators. This is also referred to as Condition-Based Maintenance.
- These determinations can be made by using a variety of data, including, but not limited to capital needs assessments, expected useful life (EUL) lifecycle schedules, or when there are technological or energy efficiency advancements that if enacted upon, will improve overall efficiencies and possibly even cost less to operate.
- Not all systems, items or components will use PdM.



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### Predictive Maintenance

<p><b>Advantages</b></p> <ul style="list-style-type: none"> <li>• Increases Component Operational Life and Availability</li> <li>• Lowers Costs for Parts &amp; Labor</li> <li>• Allows for preemptive corrective actions</li> <li>• Increases Energy Savings</li> <li>• Results in Decrease in Equipment Downtime</li> <li>• Improves Worker and Environmental Safety</li> <li>• Provides Better Product Quality</li> </ul>	<p><b>Disadvantages</b></p> <ul style="list-style-type: none"> <li>• Increases investments in diagnostic equipment</li> <li>• Increases need for and investment in enhanced staff training</li> <li>• Leaves some life left in equipment that gets wasted</li> <li>• While PdM can reduce risk of various types of catastrophic failures, none can be fully eliminated</li> </ul>
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### Predictive Maintenance

The predictive maintenance process workflow consists of the following steps:

1. Determine equipment and failure mode to be monitored
2. Establish the frequency
3. Monitor the condition(s)
4. Issue the report
- 5a. Is there an abnormality? If no, return to Step 3
- 5b. If yes, continue to Step 6
6. Create a work order
7. Schedule the work date
8. Ensure parts and labor are available
9. Perform the repair
10. Close the work order and return to Step 3



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### Predictive Maintenance

Predictive Maintenance (PdM) Tools / Technology  
 There are seven primary PdM tools commonly used. They are:

- Vibration Analysis
- Acoustic / Sound-Levels
- Infrared Analysis
- Motor Circuit Analysis
- Oil Analysis
- Ultrasonic Analysis
- Laser-Shaft Alignment



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### Deferred Maintenance Process

- In the beginning, "conditional" baselines are established
- Condition monitoring sensors are installed
- Conditional data is collected and analyzed
- Baseline breaches are identified
- A service request is then created in the system
- Required maintenance is performed
- Close out service request, then...
- Repeat the PdM workflow to identify baseline breaches or compromised system operations



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### Ensuring Consistency, Success & Ongoing Results




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Preventive & Predictive  
Maintenance and  
Capital Planning



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PM and PdM & Their Effect on Capital Planning and Asset Preservation

- Preventive maintenance (PM), predictive maintenance (PdM) and capital planning will help to ensure that replacement time doesn't come prematurely – and when it does, that you will have adequate funding to take the needed steps.
- How you manage your PM and PdM programs will have a direct effect on your site's asset preservation program and long-term capital needs. This includes how and when items are forecast and the "then" value of the replacement to ensure adequate funding sources.



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PM and PdM & Their Effect on Capital Planning and Asset Preservation

- An effective PM and PdM program will help to extend the expected useful life of the equipment, components and systems as well as help to better manage a site's ever-rising utility rates.
- A solid PM and PdM program should never be looked-upon as a "cost", but rather it should be considered an investment.
- Too many people routinely cut back on PM, and PdM to meet unrealistic projections in property budgets. This is the wrong methodology.



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**PM and PdM Integration With The Capital Plan**

**How do we tie a PM/PdM program into the capital plan?**

- If you don't have good documentation of asset history, getting a facility condition assessment (FCA) will provide you with a capital plan.
- Utilizing a computerized maintenance management system (CMMS) will help you track your maintenance after the assessment and will help to turn the assessment data into a viable performance plan. A living, breathing document so to speak.



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**PM and PdM Integration With The Capital Plan**

- A CMMS will also help integrate your PM/PdM into a capital plan by giving you full insight into your asset's facilities history and will provide ownership with a snapshot that will project how much something is worth and how much it is costing to maintain.
- When you begin to follow a healthy and cohesive PM and PdM and capital planning program, you create a controlled and manageable process that will help you plan ahead so you can minimize surprises and run the facilities instead of letting them run you.



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**Understanding The Capital Plan**

There are three primary parts to a capital plan:

- **Component List** – Outlining your assets and a schedule of all major predictable repair and replacement projects. To make an informed decision on when it will need to be replaced, you should have visibility into all work orders and how many of them were breakdowns versus PM.
- **Reserve Analysis** – Compares how much money has already been set aside in reserve to how much will be needed at specific intervals to address a site's then, needed capital projects.
- **A Funding Plan** – Identifies how much money needs to be put into your reserve fund each year to prepare for the replacement of the asset. A good goal is to 100% funded over the next ten-years, indexed for inflation.

(\* For an older asset with deferred maintenance, you can also use a *Facility Condition Index (FCI)* to decide if it makes sense to repair or replace an item. To do this, take the anticipated repair costs, divided by the replacement cost, to then, get a percentage.



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**Wrap-Up**

- ✓ You now have a much better understanding the different types of maintenance and the characteristics of each.
- ✓ You have a better understanding of the financial implications of the various types of maintenance pathways.
- ✓ You now have a better understanding of what is needed to administer an effective PM and PdM Program
- ✓ You now have some additional insight to be able to ensure consistency, success, and achieve ongoing results
- ✓ And you have learned about how PM and PdM effect you capital planning and physical asset preservation goals



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**THANK YOU**

For additional questions, feel free to contact me.

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