

# EmiratesGBC Technical Workshop #2017-1: Predictive Maintenance Techniques

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**Venue:** EmiratesGBC Headquarters, Dubai, UAE

**Date:** January 24<sup>th</sup>, 2017

**Keywords:** Reactive Maintenance, Preventive Maintenance, Predictive Maintenance, Reliability Centered Maintenance, Asset Uptime, Thermography, Vibration.

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## Introduction

All modern buildings run on either a few or a large quantity of mechanical systems and equipment that are essential for operation and successful occupancy. The quality and productivity of these systems largely depends on their effective maintenance. It is however important that the right maintenance method is applied to specific systems. There are various methodologies used to perform Predictive Maintenance for various applications. The workshop discussed how industries can increase the Overall Equipment Effectiveness (OEE) in their facilities by identifying, prioritizing, and eliminating the causes of their losses, thereby saving energy and cost.

## Overview of Maintenance Techniques

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Reactive	Preventive	Predictive	Reliability Centered
“Run to Failure”	“Calendar-based”	“Condition-based”	“Asset-uptime based”
A form of maintenance in which equipment and facilities are repaired only	Care and servicing of equipment for the purpose of maintaining it in	A technique which helps determine the condition of in-service equipment in	A process to ensure that assets continue to do what



in response to a breakdown, fault or defect.

satisfactory operating condition.

order to predict when maintenance should be performed.

their users require in their present operating context.

Requires systematic inspection, detection, and correction of incipient failures either before they occur or before they develop into major defects.

This approach offers cost savings over routine or time-based preventive maintenance, because tasks are performed only when warranted.

Emphasizes the use of Predictive Maintenance (PdM) techniques in addition to traditional preventive measures.

## Advantages and Disadvantages

### Reactive Maintenance

**No repair or maintenance undertaken on machinery until end of lifespan or machinery failure**

Pros	Cons
Lower Upfront Costs	Unplanned and sometimes catastrophic downtime and overtime hours
Lower FM costs	Secondary damage caused by failure
	Risk of higher capital costs
	Equipment/system failure dictate maintenance staffing schedule

### Preventive Maintenance

**Repairs or maintenance actions taken on machinery on a scheduled basis, regardless of actual condition of equipment**

Pros	Cons
Dramatic reduction in electrical equipment failure with regular maintenance and inspection	Fault free machines are serviced unnecessarily
Increased equipment life	More labor intensive than reactive
Reduced equipment failure	
More predictable staffing schedule	

### Predictive Maintenance

**Repairs or maintenance is performed based on changes in machines conditions, which are monitored over time with various test equipment**

Pros	Cons
Equipment is only inspected on a regular basis, and only serviced when needed	Most labor intensive practice
Lowest repair parts cost	Increased investment in diagnostic/test equipment
Increased equipment life	Increased investment in staff training
Reduced equipment failure	Cost/benefit of routine monitoring not readily apparent to management



### Reliability Centered Maintenance

Uses a blended approach between (RM, PM, PdM). Results are integrated with various technologies.

Pros	Cons
Share information between multiple technologies and all levels of the facility	Not all organizations are supportive of a full preventive or PdM maintenance program
Managers are well informed to make maintenance decisions	Large program and overhead costs; may require culture change
Balance resources with benefits	Small companies can't afford this technique

### Advantages of Predictive Maintenance (PdM)

1. PdM has several advantages over PM and RM, including higher safety factor.
2. Equipment failure can be predicted through the right tests and can be taken offline before it could fail.
3. The process, if done right, can even increase maintenance intervals.
4. Develops more confidence in maintenance schedules.
5. All this can facilitate revenue as there are fewer unexpected and serious failures.
6. Different industries and companies will have different matrixes and targets.

### Challenges of Predictive Maintenance

1. Predictive maintenance is a fairly new technique for most organizations.
2. Requires a shift of culture and work methodology.
3. Requires retraining and use of financial resources.
4. Because PdM relies on expensive imaging equipment and monitoring, it is critical that this equipment is handled by highly trained personnel for proper reading, calibration and analyses.
5. Capital investment that is inevitable is the cost of equipment.
6. PdM is fiscally more feasible for larger facilities which have dedicated people, time and budget to do the proactive work.

### Smart Tools

As downtime is getting more expensive in facilities, they are also becoming increasingly specialized. The awareness in the industry of best practices in light of increasing production demands and decreasing budgets has increased the demand for sophisticated tools which are, as technology expands, getting smarter and easier to use. As more and more maintenance practices are in-sourced, larger facilities are seeing the advantages of PdM. The following tools are used extensively with PdM maintenance. Smart tools fill the void between experts and technicians.



## Vibration Tester/Analyzer

Essential for diagnosing mechanical faults in rotating machines. Vibration remains one of the earliest indicators of a machines health. Equipment is expensive and need expert analyses. Proper prediction can greatly reduce downtime rates.



- turbine generators
- diesel generators
- paper machines
- Multi-axis machines
- ISO 10816 – mechanical vibration



- Motors
- Pumps
- Fans
- Blowers
- Compressors
- Spindles
- Gearboxes
- Belts

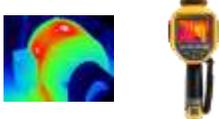


- Overall vibration
- Bearing impacting
- IR temperature
- Bearing health, **machine health screening**



- Provides overall vibration number only

## Thermal Imaging

<p>Help with finding electrical hot spots in switchgear and motor controllers, and other mechanical processes. Most mechanical and electrical issues present themselves in the form of heat which can be identified using the right thermal imager.</p>	
<h3>Oil Analyses</h3>	
<p>For finding problems with lubricant; gearboxes and reciprocating machines</p>	
<h3>Electric Testing</h3>	
<p>For finding a wide variety or electric and motor faults. Equipment can include insulation testers, as well as scope meters. Power quality correction can be achieved by restoring harmonic imbalance and results in substantial energy savings as well as reducing the risk of fire.</p>	
<h3>Corrective Tools</h3>	
<p>For precision balance and laser alignment</p>	