Condition-Based Maintenance Continuous Monitoring Strategy
Condition-Based Maintenance (CBM) Continuous Monitoring Strategy

Introduction
# Condition-Based Maintenance (CBM) Continuous Monitoring Strategy

![David Ammons](image)

## Roles and Industries

<table>
<thead>
<tr>
<th>Role</th>
<th>Industry</th>
<th>Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintenance Supervisor</td>
<td>Yazoo Industries: Tier 1 Automotive Supplier</td>
<td>1985</td>
</tr>
<tr>
<td>Maintenance Manager</td>
<td>Color Tile Mfg.: Ceramic Tile Manufacturer</td>
<td>1990</td>
</tr>
<tr>
<td>Plant Manager</td>
<td>Shelby Die-Casting: Custom Aluminum Die-Casting</td>
<td>1995</td>
</tr>
<tr>
<td>Plant Manager</td>
<td>Peavey Electronics: Circuit Board Manufacturing</td>
<td>2000</td>
</tr>
<tr>
<td>Maintenance Specialist</td>
<td>Connor Corporation: Custom Injection Molding</td>
<td>2005</td>
</tr>
<tr>
<td>Maintenance Supervisor</td>
<td>Nissan North America: Injection Molding</td>
<td>2010</td>
</tr>
<tr>
<td>Maintenance Manager</td>
<td>Nissan North America: Paint / Plastics, Body / Stamping</td>
<td>2015</td>
</tr>
<tr>
<td>Maintenance Sr. Manager</td>
<td>Nissan North America: Body/Stamping, Paint/Plastic, Central</td>
<td>2020</td>
</tr>
</tbody>
</table>
Condition-Based Maintenance (CBM) 
Continuous Monitoring Strategy

<table>
<thead>
<tr>
<th>Certification</th>
<th>Issuer</th>
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<tbody>
<tr>
<td>5 Safety Rule Regional Trainer Certification - Nissan North America</td>
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<tr>
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<tr>
<td>Society of Maintenance Reliability Professionals - SMRP</td>
<td>SMRP #160590</td>
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David Ammons
Sr Mgr Maintenance

South Central Chapter FY21-FY22 Chair
## Condition-Based Maintenance (CBM) Continuous Monitoring Strategy

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David Ammons  
Sr Mgr Maintenance

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Condition-Based Maintenance (CBM)
Continuous Monitoring Strategy

Condition-based maintenance
According to 2 sources

**Condition-based maintenance** (CBM) is a maintenance strategy that monitors the actual condition of an asset to decide what maintenance needs to be done. CBM dictates that maintenance should only be performed when certain indicators show signs of decreasing performance or upcoming failure.

Condition Based Maintenance...
fiixsoftware.com

**Condition-based maintenance** (CBM) is a maintenance strategy that monitors the real-time condition of an asset to determine what maintenance needs to be performed.

Condition-based Maintenance...
reliableplant.com
Condition-Based Maintenance (CBM) Continuous Monitoring Strategy

$ Reduce Cost $

• A CBM program's potential for a high ROI appeals to many organizations due to the fact that it can help them remain competitive and operate as lean as possible (reliableplant.com).
Overview: Automotive Assembly Plant

- T&C
- Paint
- Body
- Stamping

Process Flow
Overview: Automotive Assembly Plant

Thousands of Assets in the Automotive Manufacture / Assembly Process
Asset Management Strategy

FMEA / RPN

<table>
<thead>
<tr>
<th>Occurrence</th>
<th>Detection</th>
<th>Severity</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>3</td>
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<td>5</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>6</td>
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<table>
<thead>
<tr>
<th>Category</th>
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<tr>
<td>Extremely improbable - not likely to occur</td>
<td>Detectable - Alarm</td>
<td>Negligible, no reasonable risk of downtime</td>
</tr>
<tr>
<td>Remote - likely to occur in ops lifetime</td>
<td>Detectable - Technology</td>
<td>Slight, downtime ≤ 10 minutes</td>
</tr>
<tr>
<td>Occasional - likely to occur in a &gt; 10 year period</td>
<td>Detectable - Inspection</td>
<td>Moderate, downtime from 10 minutes to 30 minutes</td>
</tr>
<tr>
<td>Probable - likely to occur in a 1-10 year period</td>
<td>Not detectable</td>
<td>Major, downtime between 30 mins to 2 hrs</td>
</tr>
<tr>
<td>Reasonably Probable - likely to occur at least once per year</td>
<td></td>
<td>Severe, downtime &gt; 2 hrs to 8 hours</td>
</tr>
<tr>
<td>Frequent - likely to occur at least monthly</td>
<td></td>
<td>Catastrophic, downtime &gt; 8 hours</td>
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Nissan Internal
Asset Management Strategy

Rank Assets by Criticality
(Recommend at least 4 Classifications)

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<thead>
<tr>
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## Asset Management Strategy

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Critical Assets - Process Steps:
1. Prioritize the Classified Asset List
2. Determine What Asset Health Metric to Monitor
3. Determine Best Technology to Collect Sensor Data
4. Install Sensors and Establish Data Collection Process
5. Analyze Collected Data (Internal or 3rd Party)
6. Plan and Execute Asset Inspection and Correction
7. Analyze Failure Root Cause for Recurrence Prevention
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7. Root Cause Analysis for Recurrence Prevention
Asset Management Strategy

Root Cause Analysis:

1. Identify the Source of the Problem
   1. Technical Root Cause
   2. Management Root Cause
2. Mitigate Technical & Management Root Cause
3. Horizontal Deployment to all Like Equipment
Asset Management Strategy

Root Cause Analysis:

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Asset Management Strategy

Planned vs Reactive Work:

1. More Efficient than Reactive Work
   1. Kitted Parts / Supplies
   2. Documents / Procedures / Drawings
   3. Controlled Work Environment
   4. Improved Safety
Asset Management Strategy

Planned vs Reactive Work:

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Planned vs Reactive Work:

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   1. Kitted Parts / Supplies
   2. Available Documents / Procedures / Drawings

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Asset Management Strategy

Planned vs Reactive Work:
1. More Efficient than Reactive Work
   1. Kitted Parts / Supplies
   2. Available Documents / Procedures / Drawings
   3. Controlled Work Environment
2. Improved Safety
Asset Management Strategy: CBM Success Stories

Examples of CBM Findings
### Continuous Monitoring Example - Current

#### Failure Prevention case by CBM

<table>
<thead>
<tr>
<th>PLANT</th>
<th>Canton</th>
<th>SHOP</th>
<th>Trim</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diagnosis item</td>
<td>IFM Current and Voltage Monitoring</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prevented stoppage time</td>
<td>120/min</td>
<td>Effective amount</td>
<td>$81,600/USD</td>
<td></td>
</tr>
</tbody>
</table>

Motor current increased to 5.5 amps on all legs causing Senseye to trigger a case. Inspection found that TW3 had seized up and was not rotating.

![Worn spot from chain dragging on seized turnwheel](image-url)
Continuous Monitoring Example - Vibration

Failure Prevention case by CBM

<table>
<thead>
<tr>
<th>PLANT</th>
<th>Canton</th>
<th>SHOP</th>
<th>Paint 2</th>
<th>Date</th>
<th>07/15/22</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diagnosis item</td>
<td>Vibration Monitoring RTO 152</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prevented stoppage time</td>
<td>360/min</td>
<td>Effective amount</td>
<td>$244,800/USD</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Case generated by increasing trend of vibration on motor bearing. PdM UE confirmed bearing failure. Bearing replaced and fan balanced.
Continuous Monitoring Example - Torque

Failure Prevention case by CBM

<table>
<thead>
<tr>
<th>PLANT</th>
<th>Canton</th>
<th>SHOP</th>
<th>Body 2</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diagnosis item</td>
<td>Max Torque</td>
<td>Robot Axis (Rear Pillar Inr RH R251)</td>
<td></td>
<td>04/22/22</td>
</tr>
<tr>
<td>Prevented stoppage time</td>
<td>180/min</td>
<td></td>
<td></td>
<td>Effective amount</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$122,400/USD</td>
</tr>
</tbody>
</table>

Case generated on sudden shift in measured Max Torque percentage on Axis 4 of robot.
Case generated on increase of cylinder shift time for poppet closing. This also generated a change in 5 day delta. Investigation found that the cylinder closed limit switch had loosened and moved.
Continuous Monitoring Example - Temperature

**Failure Prevention case by CBM**

<table>
<thead>
<tr>
<th>PLANT</th>
<th>Canton</th>
<th>SHOP</th>
<th>Plastics</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diagnosis item</td>
<td>Temperature Monitoring VFD Cabinet (B1 Clear Ash Exhaust)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prevented stoppage time</td>
<td>360/min</td>
<td><strong>Effective amount</strong></td>
<td>$244,800/USD</td>
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Case triggered by cabinet temperature rising above threshold. Investigation found that cabinet fan had been disabled. Fan was re-enabled and temperature returned to normal.
Continuous Monitoring Strategy - Results

• Prevented Minimum of 17 Major Breakdowns from Occurring (FY21/FY22)

• Downtime Loss Cost Prevention Estimated near 66 hours (> $2 Million)
Continuous Monitoring Strategy - Next Steps

• Continue Implementation of Asset Onboarding Plan - Focus on Prioritized Critical Assets

• Assure All New Equipment Comes With CBM Capability (Sensors, etc...)

• Explore New CBM Methods for Continued Efficiency Improvement
Continuous Monitoring Strategy

Questions? / Comments!
Continuous Monitoring Strategy

David Ammons
Maintenance Sr. Manager
Canton Paint / Plastics

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