

WE HELP OUR CUSTOMERS **BUILD A BETTER, MORE SUSTAINABLE WORLD.**

Panel Discussion Use of PHM in Non-Traditional Ground Vehicles

Mike Campagna
Engineering Manager



Caterpillar Confidential Non-Confidential

Mike Campagna

- Engineering Manager at Caterpillar Inc., leading the Large Engine Analytics and Condition Monitoring Team
- Prior Caterpillar positions include
 - Engine emissions/performance
 - Cooling system/heat exchangers
 - Operations, supply chain, procurement
- B.S.M.E., M.S.M.E., M.B.A. from Bradley University



This is Caterpillar

Based on Year-end 2021 Data



4M+

Cat® Products at Work
Around the World**

**Includes discontinued products.

1.2M+

Connected Assets



2021
Consolidated
Sales & Revenues
\$51B

62%

Sales & Revenues
Outside the U.S.



160

Cat Dealers in
193 countries



107,700
Global Employees
(Full-time employment)



**Our Values
in Action**



WE HELP OUR CUSTOMERS **BUILD A BETTER, MORE SUSTAINABLE WORLD.**

PRODUCT LINES



Construction
Equipment



Mining
Equipment



Off-Highway
Diesel & Natural
Gas Engines



Industrial
Gas Turbines



Diesel-Electric
Locomotives



CATERPILLAR
FOUNDATION
CATERPILLAR®

\$850M+

Invested in global
communities since 1952

~150
Primary Locations

25 Countries



Focused on
**Sustainability
& Innovation**



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CATERPILLAR

Select
Caterpillar 'Commercial Vehicles'



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Why Condition Monitoring?

Better informed decisions to help our customers be more successful

- Control Costs
- Improve Performance
- Reduce Risks
- Manage People



Data Inputs and Health Monitoring Targets

Data Inputs

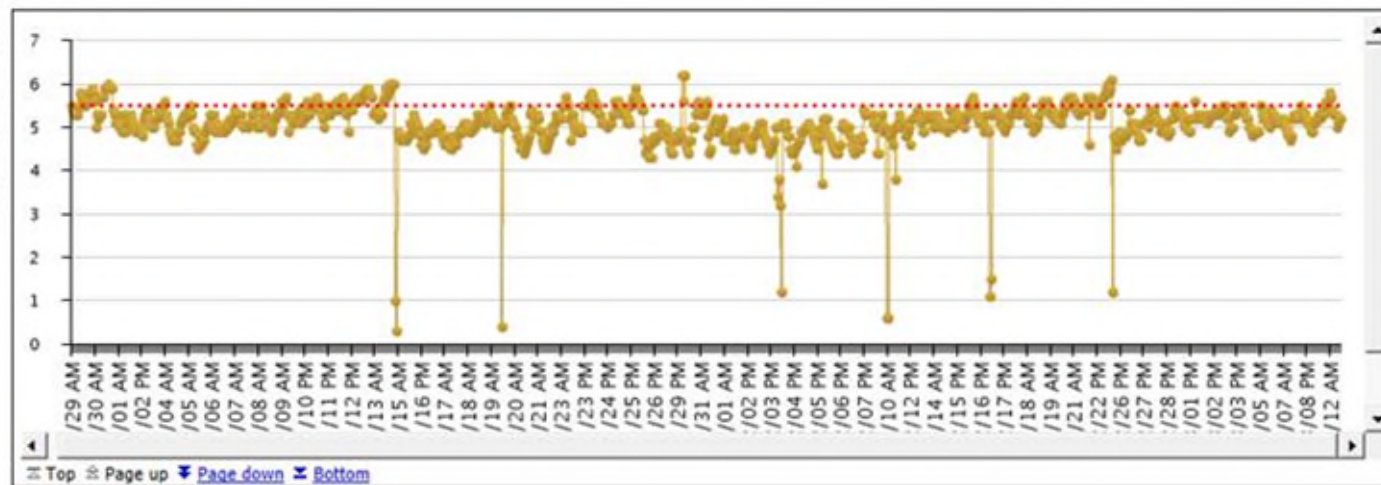
- 1 Hz Data Channels in Data Logger Files
- Trend Data
- Event Codes
- Dynamic Payload
- Loading/Hauling Cycle Times
- Fluid Analysis
- Repair History
- Site Analysis
- Inspections

Select Components for Health Assessment

- Consumables
 - Filters
 - Spark Plugs
 - Fluids
 - Ground Engagement Tools
 - Tracks
- Failure Prevention
 - Components, Systems, and Sensors
- Overhaul/End of Life Optimization
 - Major System
 - Structural Components

Example – 994 Wheel Loader

Monitored Data: Air Filter Restriction

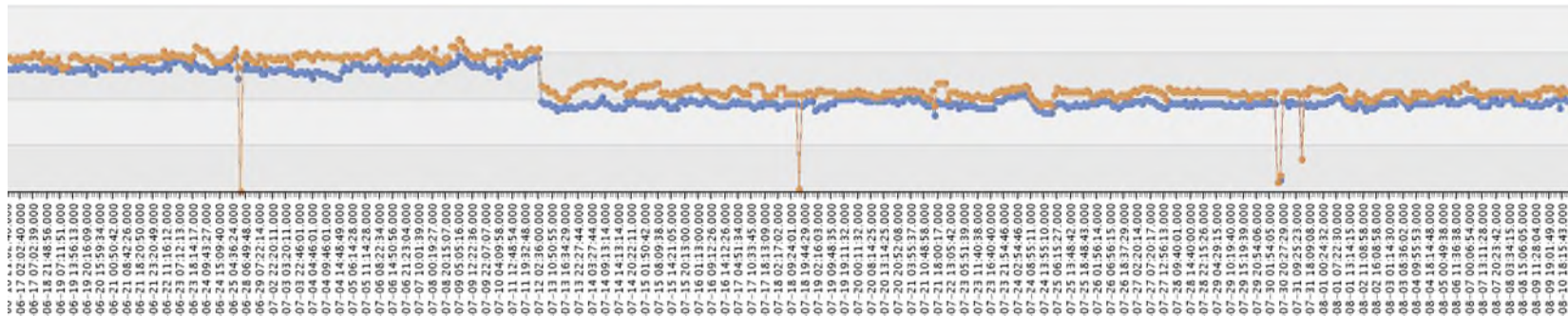


Indication air filters needed to be changed more frequently than expected.

Example – 994 Wheel Loader

Superior results for the customer come from combining domain knowledge with analytic/statistical knowledge.

Investigation: The 'top hat' section of the air intake needed to be cleaned.



Result: Air filter change interval could be extended.



Thank you



Let's Do The Work.™

There's A World That Needs Building.