

## “Intelligent Fluid Management – Real Time Monitoring”

Driving uptime improvement and cost-reduction by moving to a predictive maintenance approach

**NMEC NZ Conference  
November 2018**



## What do we have today? 5 Pain Points Every Industrial Team Faces

1. Aggressive timelines and budget constraints
2. Maximising skilled labour resources
3. Lost productivity due to equipment or process failures
4. Identifying risk when implementing improvement projects
5. Not knowing when a system requires servicing until its too late!



### OUR CASE STUDY TODAY FILTRATION & FLUID CONDITIONS



## What do we have today? Filtration Equipment Monitoring

- Filtration is installed to protect critical equipment
- Filter elements are changed on a regular cadence based on:
  - $\Delta P$  indication
  - Maintenance schedule
- Both visual and electrical indicators are used to monitor differential pressure ( $\Delta P$ )
  - **Visual** – easy to install, requires monitoring, no history of data, difficult to use to troubleshoot problems with.
  - **Electrical** – integrates into existing system, may be difficult to install, tricky to look at history.





## What do we have today?

### Filtration Performance Problems

- **Installation dates recorded remotely**
  - Card on filter housing
  - Maintenance list
- **No information on filter installation**
  - What type of filter installed
  - Is the filter installed
- **$\Delta P$  indication near end of life or by-pass valve opening**
  - What is current  $\Delta P$  across the filter
- **No length of service information**
  - When will the filter need to be changed





## What do we have today? Filtration Performance Monitoring

- Fluid parameters are inspected to monitor the system condition
- Generally fluid monitoring is undertaken in one of the following ways;
  - **Lab samples** – time and labor intensive process, highly depended on sampling method, yields vast amounts of information
  - **On-line monitoring** – difficult to install, on-site expertise required, interpretation of data, upkeep and maintenance of data management components





# What do we have today?

## Fluid Condition - Problems

- Fluid condition monitoring is mostly performed on an interval basis.
- This approach doesn't take into account condition fluctuation between scheduled reviews.
- Poor performance and excess component wear remain potential risks.

**Oil Analyzers** Lubricant Analysis Report  
North America: +1-877-458-3313

Send report results based on comments

Account Number: DLANA-1204-9576		Component ID: JOHN'S TRUCK		Tracking Number: 1204047990	
Company Name		Secondary ID: CHASSIS		Lab Number: 1402001	
Contact: JOHN Q. CUSTOMER		Component Type: DIESEL ENGINE		Lab Location: INDIANAPOLIS	
Address: 1234 MAIN STREET		Manufacturer: GENERAL MOTORS		Data Analyst: KM	
City/Town/ST: IN/TOWN, ST 12345		Model: 2500HD		Sampled: 07-Nov-2014	
Phone Number: 123-456-7890		Application: TRANSPORTATION		Received: 05-Dec-2014	
		Samp Capacity: 11 qt		Completed: 09-Dec-2014	
Filter Information		Miscellaneous Information		Product Information	
Filter Type: FULLFLOW				Product Manufacturer: ANY BRAND	
micron Rating: 20				Product Name: GRESOL OIL	
				Viscosity Grade: SAE 15W40	
<b>Comments:</b> Flagged data does not indicate an immediate need for maintenance action. Continue to observe the trend and monitor equipment and fluid conditions. Cylinder region metals (sodium, rings, liners etc.) are at a MODERATE LEVEL; Potassium is at a MODERATE LEVEL. Potassium sources: coolant (antifreeze), hose sealant or supplement, solder flux, coating on new bearings, rust preventive coating, or environmental. Boron is slightly low for this lubricant. Lubricant and filter change acknowledged.					
Sample #					
Iron	Chromium	Nickel	Aluminum	Copper	Lead
ppm	ppm	ppm	ppm	ppm	ppm
1	34	0	2	104	5
2	35	0	2	28	3
3	100	2	3	28	1
4	98	1	3	23	13
Contaminant Metals (ppm)					
SILICON	SODIUM	NICKELIUM	TITANIUM	ANTHRACENE	MANGANESE
ppm	ppm	ppm	ppm	ppm	ppm
1	482	4	4	0	0
2	44	0	0	0	0
3	45	0	0	0	0
4	46	0	0	0	0
Multi-Source Metals (ppm)					
Barium	Strontium	Calcium	Boron	Zinc	
ppm	ppm	ppm	ppm	ppm	ppm
1	882	1,014	0	895	1038
2	1080	807	0	805	1086
3	1120	869	0	884	1242
4	1227	872	0	1024	1320
Additive Metals (ppm)					
Phosphorus	Zinc				
ppm	ppm				
1	100				
2	100				
3	100				
4	100				
Sample Information					
Date Submitted	Date Received	Lube Type	Std. Time	Lube Change	Filter Change
mm/dd/yyyy	mm/dd/yyyy		min	Y/N	Y/N
14-Nov-2011	14-Nov-2011	15W-40	888	Y	Y
30-May-2012	31-May-2012	15W-40	1100	N	N
18-Jan-2014	23-Jan-2014	15W-40	2400	Y	Y
07-Nov-2014	07-Nov-2014	15W-40	2500	Y	Y
Contaminants					
Water	% Vol	% Vol	% Vol	% Vol	% Vol
ppm					
1	<1 - Estimate	0.1 - FTIR	<1 - FTIR	<1 - FTIR	<1 - FTIR
2	<1 - Estimate	<1	<1 - FTIR	<1 - FTIR	<1 - FTIR
3	<1 - Estimate	0.4 - FTIR	<1 - FTIR	<1 - FTIR	<1 - FTIR
4	<1 - Estimate	0.7 - FTIR	<1 - FTIR	<1 - FTIR	<1 - FTIR
Fuel Properties					
Acidity (mg/Kg)	Viscosity (cSt @ 40°C)	ASH (mg/Kg)	MoS <sub>2</sub> (mg/Kg)	Wear (mg/Kg)	Oxidation (ppm)
ppm	mm <sup>2</sup> /s	ppm	ppm	ppm	ppm
1	14.3	0.25	0.3	0	0
2	15.1	0.24	0.3	0	0
3	16.0	0.26	0.3	0	0
4	16.0	0.26	0.3	0	0
Particle Count (particles/ml)					
ISO Code	= 4	= 6	= 10	= 15	= 21
µm	µm	µm	µm	µm	µm
1	0	0	0	0	0
2	0	0	0	0	0
3	0	0	0	0	0
4	0	0	0	0	0
Additional Testing					
Method	Result	Method	Result	Method	Result
1					
2					
3					
4					

\* Comments are advisory only and are based on the assumption that the sample and data submitted are valid. Missing fluid or component information leads to inaccuracies. No warranty is provided or implied.

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## Use of Industrial Sensors

- Sensors, monitors, and other Internet-connected devices are increasingly being used to track, monitor, and control physical objects in production plants, traveling on ships, planes, trains and trucks, or at the store.

- Recent reporting in Fortune,

*“sensors can be used to continuously monitor machine performance, schedule preventative maintenance, and even predict breakdowns, reducing maintenance costs up to 25 percent, cutting unplanned outages up to 50 percent, and extending machine life by years.”*



Source: Manyika, James and Michael Chui. “By 2025, Internet of things applications could have \$11 trillion impact.” Fortune. Jul 22, 2015 <http://fortune.com/2015/07/22/mckinsey-internet-of-things/>



## Use of Industrial Sensors in Hydraulic and Lubrication Systems

### Filtration Equipment Monitoring

- Differential Pressure
- Fluid Temperature
- Filter Information – Model, Manufacturing, Installation info
- Remaining Filter Service Life



### Fluid Condition Monitoring

- Fluid Temperature
- Fluid Viscosity
- Density
- Dielectric Constant
- Contamination Level
- Water Level





# Big Data and Predictive Analytics

## Data Collection

- Sensors continually monitor filter performance and fluid condition
- Large amount of data – “Big Data”
- Too much data to store or analyze locally

## Data Analysis and Reporting

- Data is transmitted via wireless network to the cloud
- Intelligent software translates the data, maps it against historical trends, process variables, and predictive algorithms,
- Data then presented through a reporting and notification system – Predictive Analytics



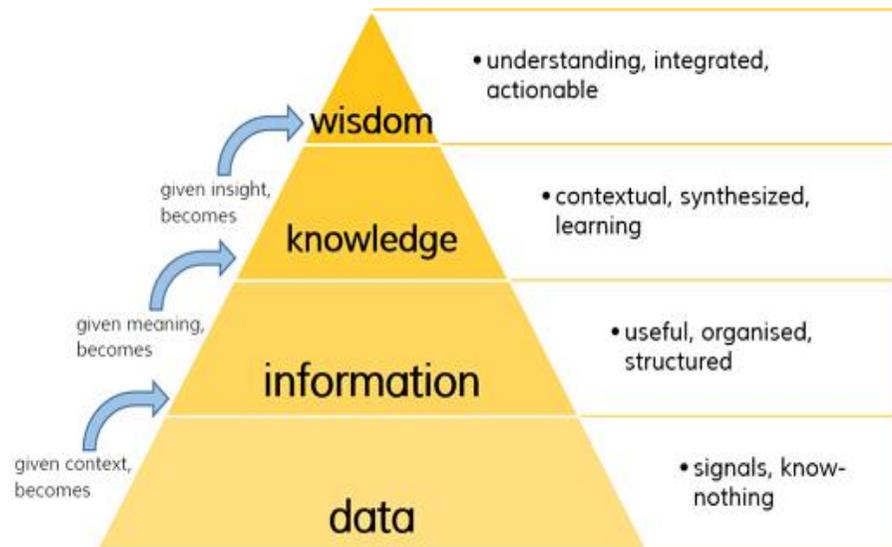


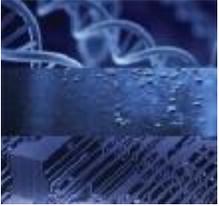
# Predictive Analytics

In order to draw useful knowledge from data, analysis must be undertaken.

The purpose of this analysis is to;

- Give Context to the data, &
- Offer insight into **how** and **why** the data changed





# Predictive Analytics

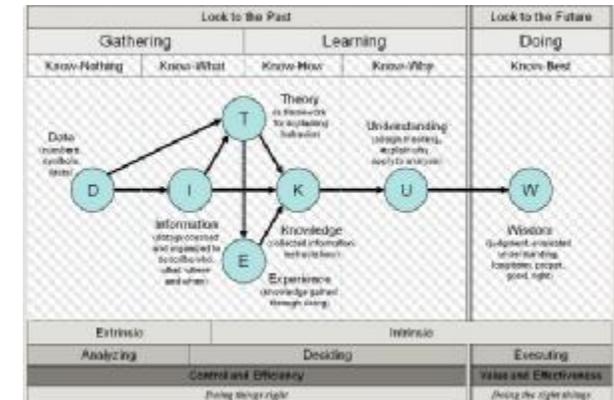
Once the how and why is understood we can then identify leading indicators of events well before the event has occurred.

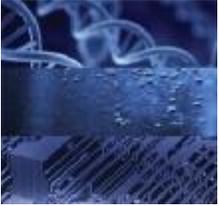
## This is **Predictive Analytics**

Predictive Analytics example: Using  $\Delta P$  to determining element life.

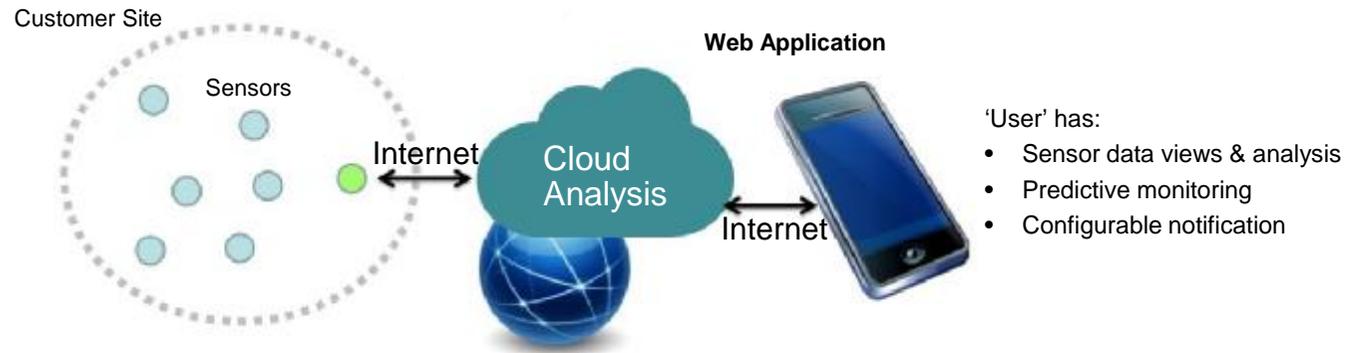
**Data**  
**Information**  
**Knowledge**  
**Wisdom**

$\Delta P$  i.e. 35psid (2.5bard)  
max  $\Delta P$  = 50psid, 50 days in service  
Element is approaching end of life  
Element has 10 days of life left





## Cloud Based Data Storage and Analysis

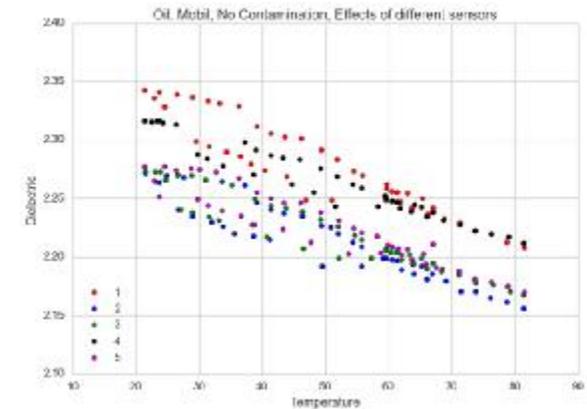
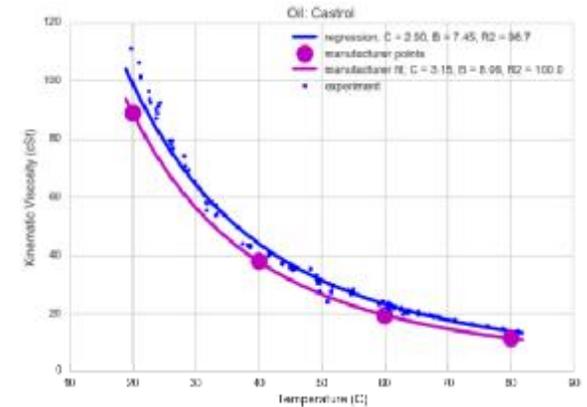


Users have real-time access to their monitors and to historical trending of process data, system health status, and notifications stored in the cloud:



# Predictive Data Analytics

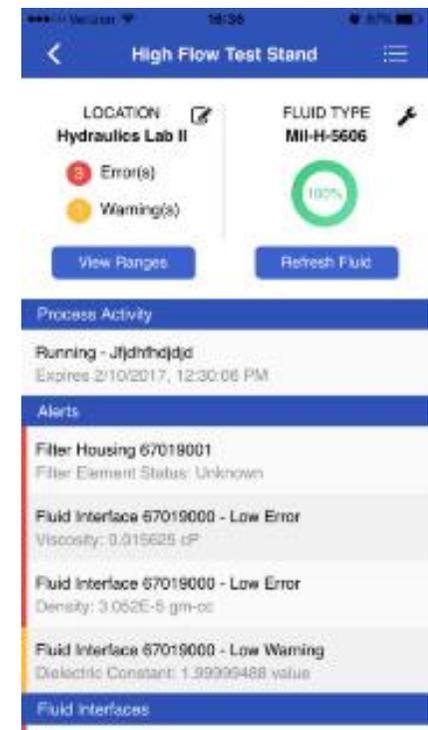
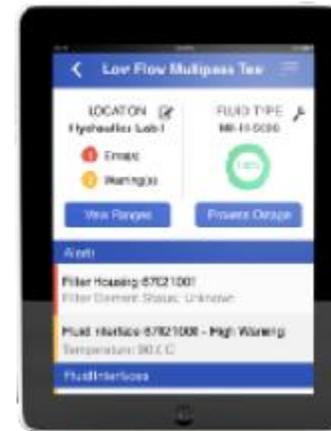
- Industrial sensors can be used to monitor filter and fluid conditions in lubrication and hydraulic systems
- Using the raw sensor data, cloud based algorithms are used to calculate system critical information which is easily interrelated and acted upon by users. Information obtained from the algorithms include;
  - Generic system health
  - Filter life remaining
  - Troubleshooting assistance
  - Indication of fluid changes





## Predictive Data Analytics

- The predictive data analytics package will also have the ability to learn from the fluid system.
- By analyzing the historic trends of the system future behaviors can be predicted more accurately.
- Analysis can be locally accessed via a tablet or smart phone, helping streamline the maintenance process and improve site efficiency.
- This means less downtime through mitigation strategies being put in place, and predicting maintenance upsets before they occur.





## Addressing the Pain!

### Lower Maintenance Costs by up to 30%

- Reduction in filter spend
- Less labor hours required to maintain filtration and fluid systems
- Optimize filter element change out intervals and

### Reduce cost of unscheduled shutdowns by more 50%

- Greatly increase chances of detecting failure events before they affect the system
- Speed up root cause analysis to determine the best actions that need to be taken to prevent a failure

### Increase productivity by up to 40%

- Enable site to focus on functions critical to production, improving yields
- Decrease the loss of production and lose of labor hours associated with unscheduled shutdowns



## Summary

- § Existing filter performance and fluid condition monitoring methods are hard to install, output limited data and do not provide data interpretation
- § Using a series of in line sensors connected to a cloud based reporting system, real-time availability of data instantly flags performance issues and warns of potential problems and provides predictive analytics of the system health
- § Analysis can be locally accessed via a tablet or smart phone, helping streamline the maintenance process and improve site efficiency
- § Analysis results in less downtime through mitigation strategies being put in place, and predicting maintenance upsets before they occur



***Thank You !***

***Any Questions ?***