Delivering High Value Condition Monitoring at Caterpillar

Presented by **Tarun Mannepalli**

CATERPILLAR®

A Global Reach

- Global reach and presence is unmatched in the industry
- Serve customers in more than 180 countries around the globe
- More than half of our sales are outside the United States
- Manufacturing, marketing, logistics, service, R&D and related facilities along with our dealer locations total more than 500 locations worldwide

Dealers

- 188 worldwide with more than 126,000 employees
- Independent, locally owned
- Key competitive advantage

A Broad Range of Products and Industries

Cat equipment – more than 3 million pieces globally – is at work for our customers on highways, rail lines, oceans and rivers, in forests, quarries, mine sites and oil fields.

Caterpillar in India

An example of one of the first Caterpillar machines sold in India

1936 – First Caterpillar Machine sold in India
1937 – TIL opens dealership in India
1967 – Caterpillar dealership GMMCo was established
2001 – Hindustan Motors in Tiruvallur acquired renamed as Caterpillar India Pvt Ltd.
2006 – Hindustan PowerPlus acquired, merged into Caterpillar India in 2008

R&D Centers located in Chennai & Bangalore

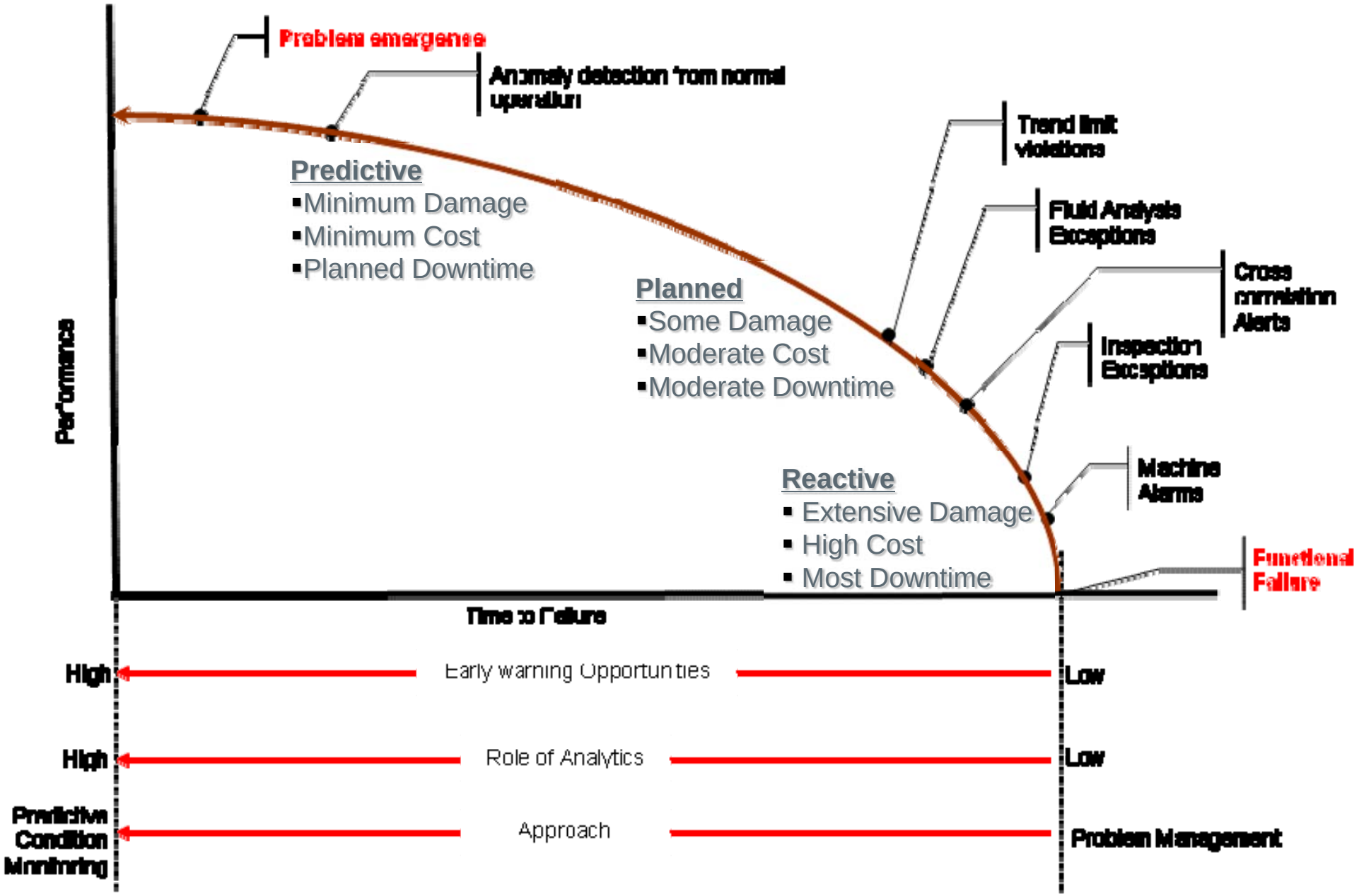
Condition Monitoring

Turning Equipment Data into Actionable Information

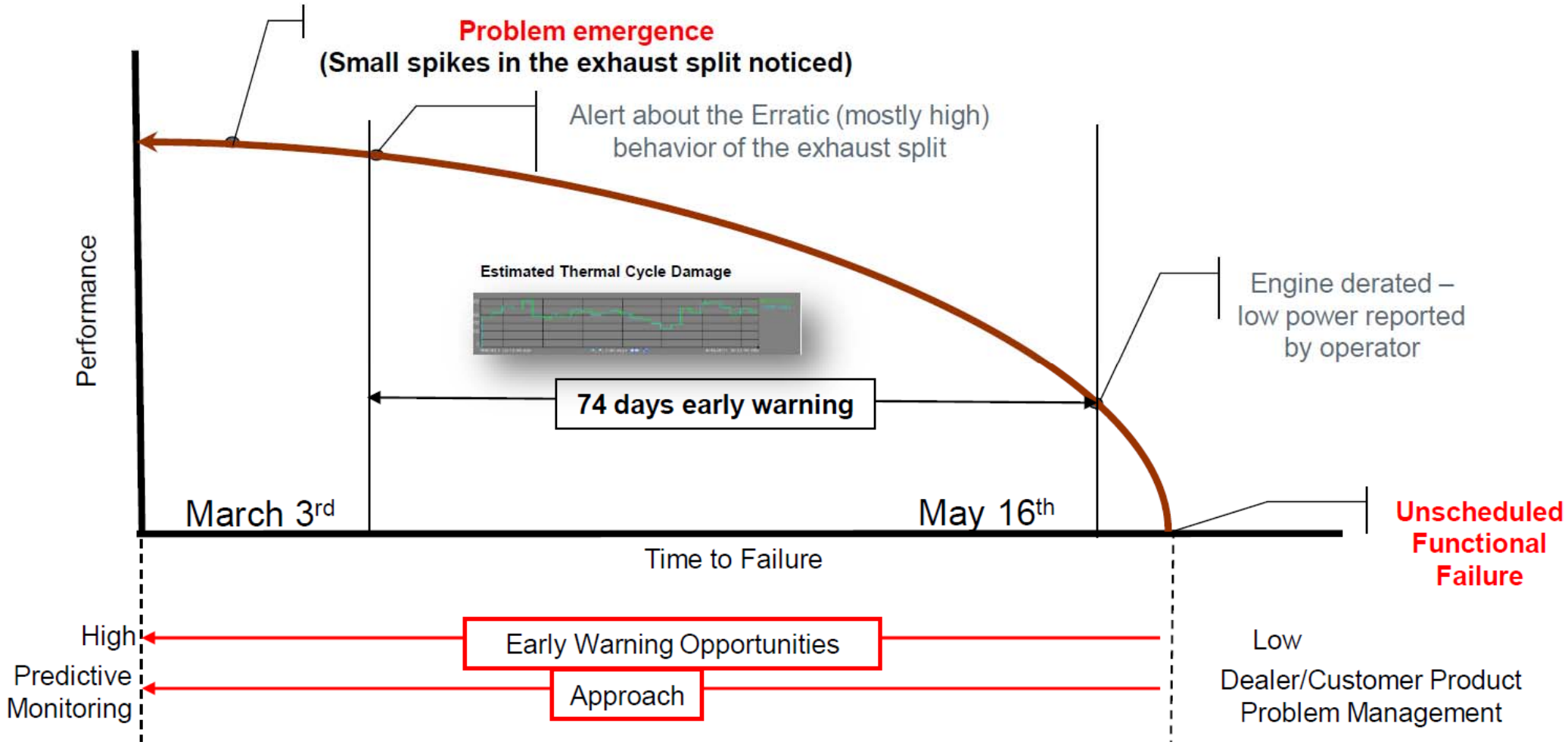
Creating notifications that are
valid and actionable. Its about the end user's trust of the system and its proven history.

CATERPILLAR®

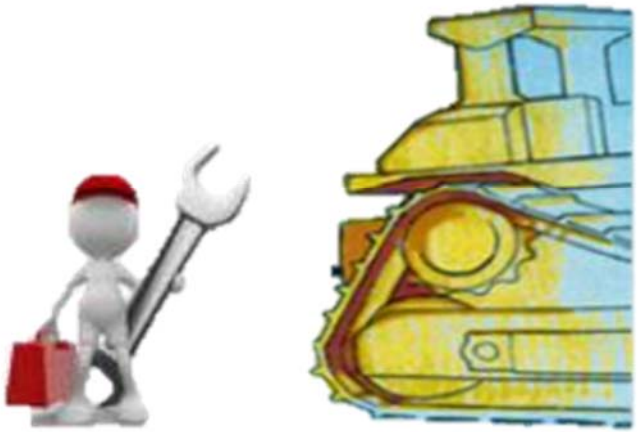
Leveraging Early Warning



Why Focus on a Sensor/Harness Issue?



Business Challenge



From information overload…….

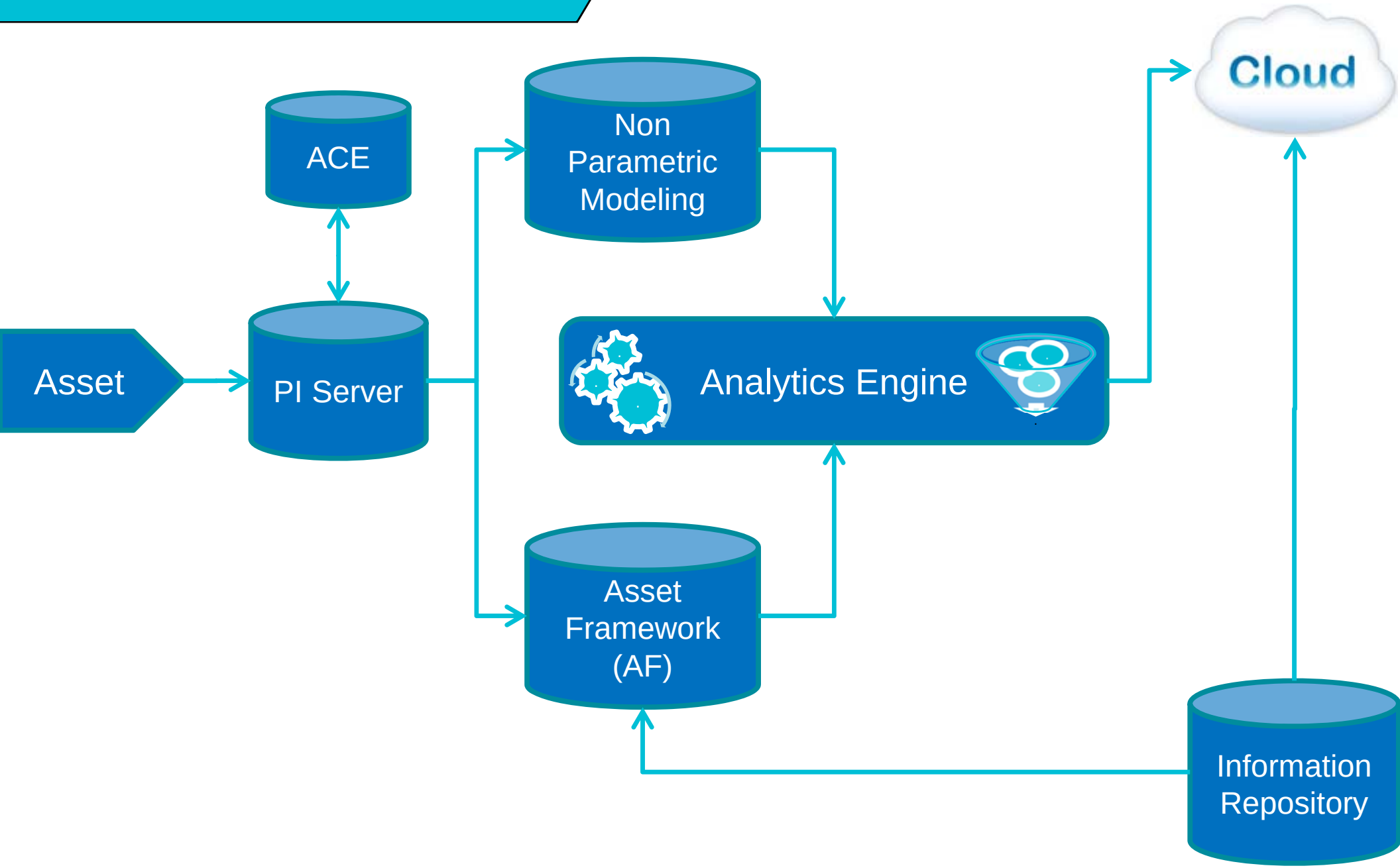
……To actionable intelligence

- Engage *end user*
- Visualize analytics in a way that's easily understood
- Help the *end user* understand the problem to make more intelligent repair decisions

Condition Monitoring - Challenges

- Getting data back consistently from mobile assets is a huge challenge
- Assimilating the data and building an analytic structure to process it.
- Turning the data into actionable information that the end user (repair planner) can fully understand and trust to help him make more efficient, accurate repair decisions

Architecture



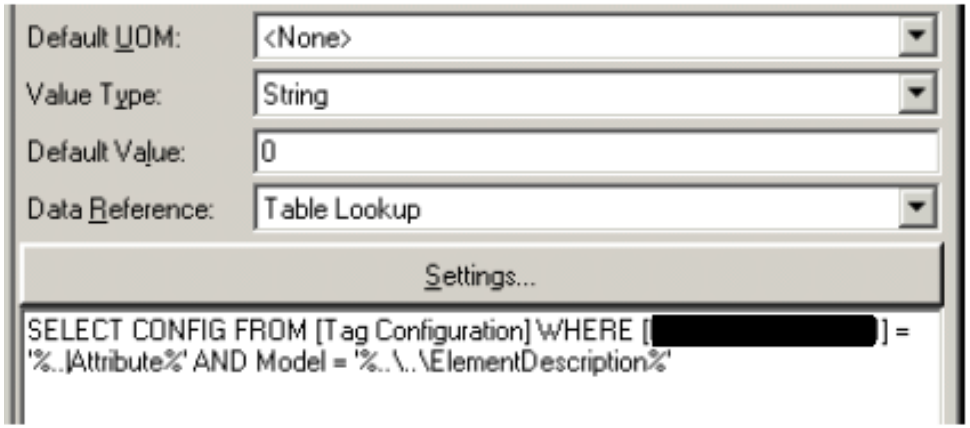
Equipment Hierarchy in AF

Single Point Data Aggregation

	MODEL_CODE	SRC	TAG	COMPDEVPERCENT	EXCDEVPERCENT	SPAN	STEP
1	793F	3	Steering Accumulator Oil Pressure-Chassis Ctrl(67407.0)	1.2	0.6	24000	0
2	793F	3	Steering Pump Oil Pressure-Chassis Ctrl(65790.0)	1.2	0.6	24000	0
3	793F	0	Strg Pump Pres(991)	1.2	0.6	24000	0
4	793F	0	Brk Pump Spd(377)	1.11	0.55	1800	0
5	793F	0	DesFuelRail Prs(1305)	1.11	0.56	180000	0
6	793F	0	Actual Gear(348)	1	1	100	1
7	793F	3	Actual Gear-Trans Ctrl(67300.0)	1	1	7	1
8	793F	3	Air Filter #1 Restriction-Engine(70408.0)	1	0.5	6	0
9	793F	3	Air Filter #2 Restriction-Engine(70409.0)	1	0.5	10	0
10	793F	3	Air Filter #3 Restriction-Engine(70410.0)	1	0.5	10	0
11	793F	3	Air Filter #4 Restriction-Engine(70411.0)	1	0.5	10	0
12	793F	0	Air Flt Rest #1(1311)	1	0.5	10	0
13	793F	0	Air Flt Rest #2(1312)	1	0.5	10	0
14	793F	0	Air Flt Rest #3(1313)	1	0.5	10	0

Referenced Templates in AF

Table References within all attributes



Attributes Referenced to allow changes at a single source

Meaningful Analytics

Customized Simple Analytics

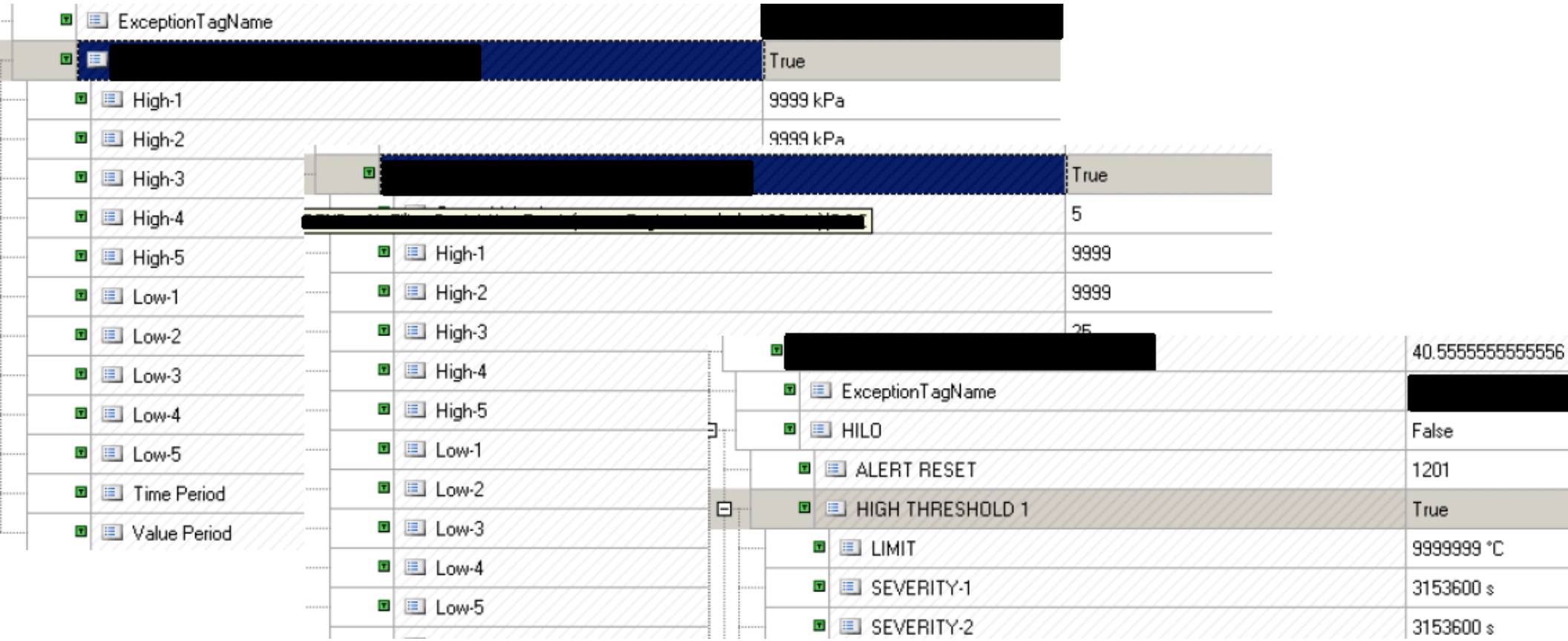
- Trend Violation, Statistical Methods, Alarms

Advanced Analytics

- Anomaly Detection from Normal, Custom Alarm, Smart Analytics

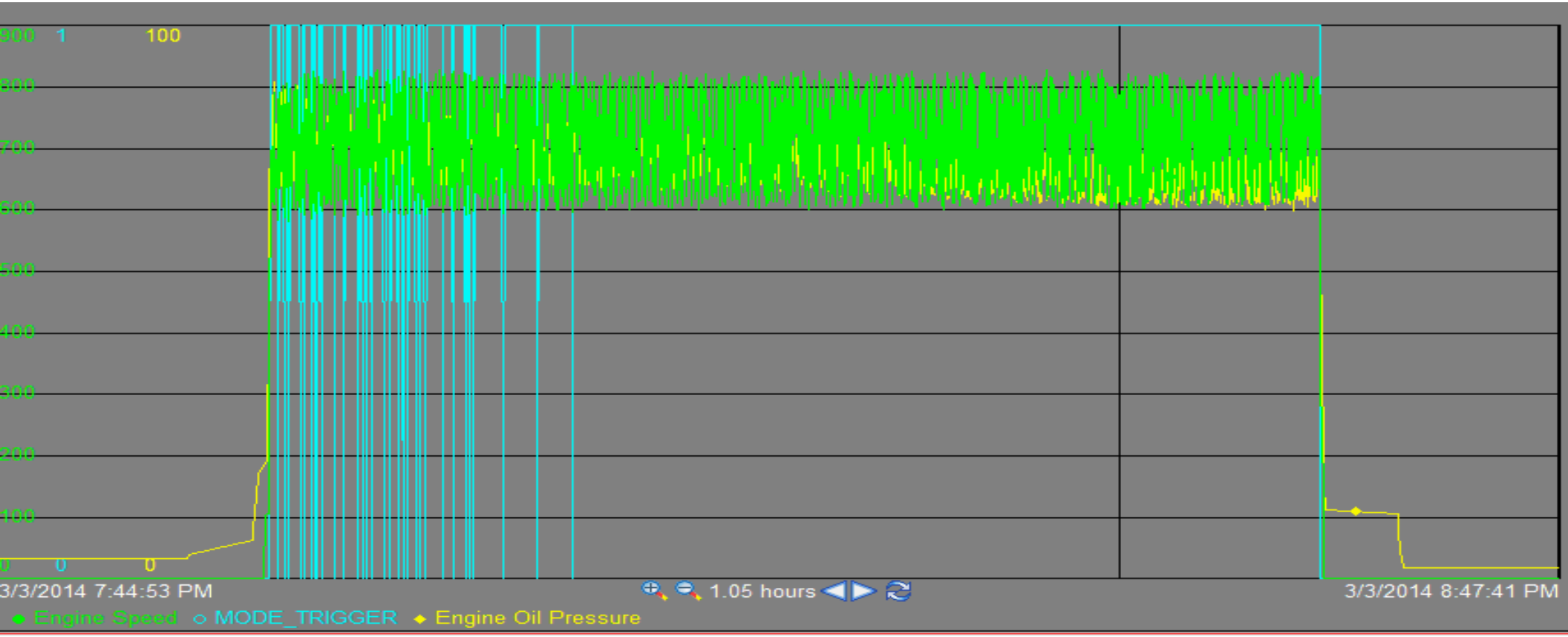
Models Mapped within AF

Model parameters configured within AF



Operating Modes

Different Operating Modes Require Different Limits



Customizable Limits on Demand

HILO	True
High-1	66.7 delta °C
High-2	50 delta °C
High-3	33.3 delta °C
High-4	9999 delta °C
High-5	999999 delta °C
Low-1	-66.7 delta °C
Low-2	-50 delta °C
Low-3	-33.3 delta °C
Low-4	-9999 delta °C
Low-5	-999999 delta °C
Time Period	*-24h
Value Period	7

PI CoreSight Integration

Occurrence Summary

Number of Occurrences	Data Element	Analytic Model	Channel Id	Channel Name	Data Analysis
13	REAL_TIME_DATA		Fuel Temperature		
2	REAL_TIME_DATA				
1	REAL_TIME_DATA		Fuel Temperature	Fuel Temperature	Data Analysis

Occurrences (16) First Occurrence: 1/3/14 12:13 PM Last Occurence: 1/17/14 9:18 AM

Date of Occurrence	Severity	Analytic Model	Data Element
1/17/14 9:18 AM	5 Minor		REAL_TIME_DATA
1/16/14 12:36 PM	5 Minor		REAL_TIME_DATA
1/15/14 7:24 AM	5 Minor		REAL_TIME_DATA
1/14/14 3:20 PM	3 Major		REAL_TIME_DATA
1/14/14 2:12 PM	5 Minor		REAL_TIME_DATA

Value of Condition Monitoring

Benefits for Customers

- Information vs. data
- Less labour to identify repair recommendations
- Better equipment utilization
- Reduced unit operating costs

Benefits for Caterpillar and Dealers

- Differentiation in the marketplace
- Long-term partnerships with our customers
- Improved understanding of equipment applications

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Tech Lead

Caterpillar India Pvt Ltd.

THANK YOU

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