Leveraging Digital Technology to Optimize Equipment Operation and Maintenance

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Caterpillar Overview

- $1.9 Billion Annual R&D
- Over 600,000 Connected Assets
- Over 700 Million Tons of Material Moved by Autonomous Mining Trucks

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Caterpillar Oil & Gas Segments

Gas Compression
Well Service
Drilling
Production

Primarily Upstream and Midstream

Over 15,000 Connected Assets
Key Challenges We Face in Today’s Oil & Gas Industry

• Cost Pressure

• Shortage of Skilled Workers
Caterpillar’s Role in Meeting These Challenges

Use of Digital Technology + Domain Expertise:

• Smarter Machines
• Integrated Drivetrain Systems
• Remote Monitoring – Connectivity
Digital Technology + Integrated Drivetrain

1. **PEMS** – Pump Electronic Monitoring System
   • Provides pump operating conditions, prognostics and diagnostics (over J1939) to warn the operator of leak or cavitation, to prevent damage to the pump
     ✓ $512k Annual Cost Savings*

2. **DTOC** – Dynamic Transmission Output Control
   • Transmission software control features (All J1939)
   • Allows the operator to directly command flow rate
     ✓ Simplified frac rig (or full frac spread) operation
   • Includes Economy Mode shift schedule
     ✓ $192k Annual Fuel Savings*
   • Includes Automated Pressure Test Mode
     ✓ Provides a “1-touch” pressure test routine that is Safe & Accurate

3. **EIRS** – Engine Idle Reduction System
   • Allows for automatic engine shutdown and remote (electric) startup via J1939
   • Reduces idle time by 60% and save 8.5% in annual fuel consumption
     ✓ $217k Annual Fuel Savings*

*Assuming a 16 unit frac rig fleet

Combined $921k annual O&O cost reduction per fleet for the customer & improves safety

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Example of Cat Connect Alert Escalation Process

**Gas Compression Unit**

- **2 July 2014**: Check compressor valve
- **10 July 2014**: 1st Escalation
- **18 July 2014**: 2nd Escalation
- **24 July 2014**: 3rd escalation and failure at 6:57PM
- **25 July 2014**: Back Online at 9:01PM

**Value**

- $100,000 lost production at $3.00/MCF
- ~ $30,000 to $40,000 parts and labor

= $130,000 TOTAL LOSS

*(Recommended repair cost <$2000)*
Example: Text Alert Saves Drilling Rig Engine from Overheating

- TEXT ALERT to Equipment Manager at 2:00 AM warns of Low Coolant Level
- MANAGER calls rig and onsite crew discovers leaking hose
- Coolant Level is Topped Up and Leak is Repaired
- Downtime and Emergency Callout Avoided
Example: Remote Detection of Improper Maintenance

SYMPTOMS:
• Erratic Exhaust Port Temperatures and Excessive Fuel Consumption

ROOT CAUSE
• Improper Valve Adjustment on One Bank of 12 Cylinder Engine

VALUE DELIVERED
• Unscheduled Downtime and Emergency Service Callout Were Avoided
• Training Program Improved
Example: Detection of Plugged Oil Filter

• Cat Fleet Manager identified oil filter plugging after an oil change
• Oil filter was not replaced during the oil change
• Filter was replaced at next shutdown, preventing an unscheduled outage for high filter differential P shutdown
Example: Fleet Advisor Diagnoses Emerging Issue Using Mobile Device at Airport

- Cat G3608 with Advanced Condition Monitoring
- Cat Fleet Advisor Receives Alert and Identifies Faulty Spark Plug
- Informs Site Personnel who replace Spark Plug during planned shutdown later that day
- Unscheduled Downtime and Emergency Callout Avoided
Next Phase - Remote Troubleshooting and Software Update

Remote troubleshooting is a new technology enabling customers and Cat dealers to remotely perform most Caterpillar Electronic Technician (Cat ET) service tool tasks.

**BENEFITS**

- Lower costs – technician, travel
- Reduced downtime
  - Faster troubleshooting
  - Reduced time to repair
- Troubleshoot without a site visit
  - Avoid site visit when no fault found
- Increase the speed of repair by being better prepared to arrive to site
  - Right parts, Right technician skills
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